SCIENCE

AN ILLUSTRATED JOURNAL

PUBLISHED WEEKLY

VOLUME III

JANUARY—JUNE 1884

CAMBRIDGE MASS.
THE SCIENCE COMPANY
1884

Franklin Press:
RAND, AVERY, & COMPANY,
BOSTON.

CONTENTS OF VOLUME III.

SPECIAL ARTICLES.

BOOK REVIEWS.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

LIST OF ILLUSTRATIONS.

// SCIENCE.

AN ILLUSTRATED JOURNAL PUBLISHED WEEKLY.

Vérité sans peur.

CAMBRIDGE, MASS.: THE SCIENCE COMPANY.

FRIDAY, JANUARY 4, 1884.

COMMENT AND CRITICISM.

THE thoughts and actions of young men of intellectual strength, in whom is vested the future fate of scientific progress in this country, are worth attention, and are of the deepest interest to those who are, or soon will be, no longer explorers of new fields. The meeting last week in New York, of the new society of naturalists, composed almost wholly of young men, was remarkable for the force and directness of the discussions, and the absence of pointless and wearisome talk. It became plain that we have men capable of the best work, and that we are preparing for a brilliant future of investigation, whenever the instrumentalities necessary for fullest success are sufficient. The spirit of independence, and the disregard of purely personal influence, were as great as could be desired. All propositions, from whatever source, met with an equal and critical treatment; and no clique or locality had the slightest claim for consideration. Philadelphia was best represented; while there was a striking absence of delegates from Washington, New Haven, and Cambridge.

THE International conference for fixing upon a universal prime meridian and a universal system of time has at length been called by the State department to meet in Washington, Oct. 1, 1884. Diplomatic proceedings are always expected to go on with a certain dignified leisure; but the arrangements for the meeting of this conference have been delayed far beyond any thing customary, even in diplomacy. The act authorizing the conference became a law in August, 1882. As there was some doubt whether there would be a sufficiently general response to the invitation to insure the success of the conference, a preliminary circular requesting the views of the various governments interested, and an expression of their willingness to enter the conference, was issued from the State department toward the end of 1882. The responses were in some cases favorable, and in others negative or undecided. A desire was felt by the Europeans to have a preliminary discussion of the subject at the International geodetic conference at Rome in October, 1883. The feeling at this conference having shown that there would be little difficulty in the universal adoption of the Greenwich meridian, the final step of calling the conference was taken. Why so late a date was chosen we are not informed.

IN our issue of Dec. 14 we published an article under the title of 'The signal-service and standard time,' criticising the action of the chief signal-officer in not adopting the new standards of time at signal-service stations. We have since learned that our criticism was not well founded, as the information upon which it was based gave an incomplete idea of the position of the service in this matter. It is true that the observers of the service are still governed by the local times of their respective stations; but this is only a temporary arrangement, and will be changed as soon as possible. The reason of the delay is this: the international observation, which is taken at many stations of observation throughout the whole world, is made at seven A.M., Washington time. It is proposed to make this observation eight minutes earlier, or at seven A.M. of the time of the 75th meridian, which is exactly Greenwich noon; but, before this change can be made, the co-operating weather-services and numer-

ous independent observers must first be notified, and their consent obtained. Correspondence has already been begun, and a circular letter sent to all who co-operate in the international work, asking consent to the proposed change. Favorable replies are being received; and there is little doubt that the change will be made, probably Jan. 1, 1885. It should be remembered that the international observation is made largely by observers who kindly co-operate with the chief signal-officer, but who are not under his orders: a change of this kind cannot, therefore, be summarily ordered, but must be made by mutual consent.

It would, of course, be easy to make the change in this country without waiting for the action of observers elsewhere; but this was thought inadvisable. It is a mistake, however, to suppose that the observers are really governed by local times. All observations are made at seven A.M., three P.M., eleven P.M., or other hours of Washington time, and have been so made ever since the establishment of the weather-service. Under Gen. Myers's management, it was thought that it would save confusion at the several stations if the observers kept their clocks at local times instead of Washington time, and observed at the proper corresponding times. This arrangement continues at the present day, though the observations are in reality all made on Washington time. Now, in view of the proposed change in the time of the international observation, it was thought inadvisable to make any change in existing arrangements until the whole change required could be made at one time. The chief signal-officer is in full accord with the reforms in standard time now being introduced, as he has shown in many ways; and he proposes to bring the whole work of the service into conformity with the new system as soon as this can be done without introducing confusion in the different departments of the service.

For more than three hundred years, access to the sacred city of Villa Rica, in Araucania, has been prevented by the Indians. Its name indicates its importance and wealth in the days of Indian supremacy. Now it is a mere collection of ruins, overgrown with herbage and shrubbery; though the forms of antique monuments and buildings are still traceable, and invaluable for archeological study. Very recently, Chile has taken possession of the territory; and its treasures of antiquity are, or will soon be, accessible to ethnologists.

A scheme for conveying brine by pipes from the Cheshire salt-fields to the Mersey, for manufacture there, was started two years ago. The pumping-works are erected, but so far with no results. The scheme was floated on the London exchange; but no 'salt man' joined therein, the general opinion being, that in flowing through pipes for so long a distance the salt would cake, and the stopping-up and corrosion of the pipes would necessitate repairs sufficient to swallow up profits. This would apply to the western New York and Lehigh valley scheme.

It is to be hoped that the state weather-services, of which several are now established, will give attention to questions apart from the ordinary statistical side of meteorological observation, which at present takes so much of their time. Thunder-storms especially need detailed examination from many closely placed observers, such as the state services may possess; for these storms are commonly so small that they often slip, unobserved, through the necessarily coarse meshes of the general signal-service network of stations.

There are as yet, in this country, no observations — at least, none published — of duration or detail sufficient to determine how many hours before its arrival a thunder-storm can be foretold. The antecedent conditions, the area, the average and abnormal tracks, and the duration of these small storms, have yet to be carefully studied. The blowing of the winds about them is imperfectly known. There are no data for determining the relation of the fre-

quency and violence of lightning to the different parts of the storm-area, or for discovering its possible preference for one or another topographical or geological district when it 'strikes.' Some of these points have been studied in Europe, but much remains to be done even there. Indeed, there is no department of meteorology in which local and closely placed observers can attain an end so distinctly original, and so far out of reach of the government service, as in this; and ten years' observations from stations near one another, and numerous enough, would yield results of the greatest practical and theoretical interest.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Mr. Francis Galton's proposed 'family registers.'

MANY obliging letters reach me from America, offering family information for my use, of the kind described by my friend, Mr. Henry F. Osborn, in your issue No. 39, as that which I want.

The scheme there described is one that I circulated to gather opinions and to obtain guidance before determining its precise form. This is now done, and with your permission I will say a few words upon it.

The information wanted applies to so many different individuals in the same family group, and differs so much in minuteness, according to the degree of kinship, and it has to be arranged in so special a manner, that a copious explanatory description and numerous tables are requisite. There is no real complexity; nevertheless, I feel assured, that, without considerable guidance, endless mistakes will arise. Correspondents will send pages of useless matter; and, on the other hand, they will be silent about simple facts, the absence of which will seriously diminish the value of otherwise copious returns. I therefore found it necessary to prepare a book containing a full account and explanation of what was wanted, in order to exhibit the varous hereditary tendencies that converge upon any given person, and containing at the same time all the necessary schedules. This I have done: it is in the press, and will be published about Christmas by Macmillan, and will be procurable in America.

As regards the prize scheme, I found it inadvisable to restrict it to medical men, and I have thrown it open to 'British subjects resident in the United Kingdom.' I could not extend it farther, owing to the extreme difficulty of verifying statements of facts alleged to have occurred abroad. My self-imposed task will be hard enough as it is. The conditions of the prizes are fully explained in a fly-leaf to the English edition.

Let me take this opportunity of saying a few words about another book to which my name is attached as editor, and which will appear at the same time. It is called the 'Life-history album,' and was prepared by a sub-committee, of which I was asked to be chairman, who acted by direction of the Collective investigation committee of the British medical association. This book gives explanations and schedules for the registration of *personal* data as life advances, just as the *Record* gives for a comprehensive account once for all of *family* data; the details, however, being very different in the two books: they are much more medical in the 'Album.' It is believed by the Life-history sub-committee that the medical value to the possessor, of his own life-history up to date, would be considerable, and of great service to the children. They also feel, that, if these albums are commonly kept, it will be possible hereafter to obtain extracts of a great many of them for purely statistical purposes, which would be of high scientific value. The albums will contain a vast amount of information which is now left to perish, and the lack of which is a great hinderance to obtaining that complete and comprehensive knowledge of the family antecedents of numerous persons, which is at present the paramount desideratum to inquirers into heredity.

I shall be very grateful to any of your readers who may see my forthcoming 'Record of family faculties,' and may make themselves acquainted with what I want, who will send me information concerning their own families. But I cannot explain my wants with sufficient brevity either here or by letter, and must, perforce, refer those who care to know them to the book itself. FRANCIS GALTON.

42 Rutland Gate, London, December, 1883.

The red sunsets.

I have recently noticed several articles upon the gorgeous sunsets lately seen in this country, and desire to put down a few notes on the same.

The red glare was so brilliant the evening of Nov. 27, that the fire-alarm was sounded in New Haven, Conn., calling out the engines. On the succeeding night the deep red glow was magnificent, appearing far above blocks in the busiest part of the city. Careful observation has shown the phenomenon very nearly as brilliant at sunrise as at sunset. The deep red has appeared the last of all the *colors* in the sky at sunset, and invariably the first in the morning. There has been, in addition to this, a grayish afterglow at night, and in the morning a slight effulgence betokening the rising sun. This afterglow, or effulgence, has made it possible to observe the sky directly at the region where the deep red had just appeared, or was soon to appear; and this invariably showed fine fleecy clouds at a great height, generally stratified horizontally, and extending with slightly increasing density to the south-west or south-east horizon. These light stratified cloud-appearances were visible, even though the sky appeared absolutely cloudless a few minutes before and after the effulgence. The stars the past month have shown, night after night, most extraordinary twinkling, and the air has been saturated with moisture. Again and again, with a high barometer and a perfectly clear sky, sometimes even with a cold north-west wind, I have been astonished to find the relative humidity a hundred per cent.

As to a probable explanation, the wildest theories have been advanced: meteors, cosmical dust, zodiacal light, comets, electricity, volcanic gases and ashes, etc., have each had their adherents. Of these, the last is the only one worthy of consideration. The recent (?) eruptions at Java, 11,000 miles distant, are advanced as a sufficient cause for the presence of the ashes.

That volcanic ashes may be carried great distances is well known. Loomis's 'Meteorology,' p. 77, gives an instance in which ashes were carried 700 miles to the north-east and 1,200 miles to the west of the volcano Coseguina. Notwithstanding this evidence, it

would seem well-nigh incredible that the upper currents and the power of suspension of the ashes could have combined in carrying the particles 11,000 miles.

Common cloud-coloring is caused by diffraction from particles of dust or water-droplets. Light of different wave-lengths has a greater or less power of passing through dust, smoke, water-droplets, ice-spiculae, etc. It is stated that the light at the blue end of the spectrum has less power of penetration than at the red end: hence the light is sifted out, as it were; and the blue disappears first, then the orange, and, last of all, the red (Scott's 'Meteorology,' p. 205). Why may it not be possible that the blue, having the greater refrangibility, is refracted to such an extent as to be intercepted by the earth long before the red has disappeared? Taking into account the great abundance of moisture, the appearance of ice-spiculae (which, however, may have been volcanic ashes), and the fact of the appearance being precisely similar to that ordinarily seen upon clouds, there is no necessity of resorting to the at best doubtful theory of the volcanic origin of the phenomenon.

The similarity between the ordinary sunset and this phenomenon was finely illustrated one evening by a magnificent red-cloud sunset, manifestly caused by clouds comparatively near the observer. These clouds, gradually fading away, were followed by the deeper red so prominently noticed recently, and evidently produced by ice-spiculae at a great distance.

G. A. N.

ON the evening of Dec. 22 a red glow was noticed upon the clouds which overspread the whole heaven. On the 23d the cloudiness was complete, and even denser than on the previous evening; but the glow tinged the whole visible vault down to the eastern horizon, and continued for at least an hour after sunset, fading first in the east. On the 24th the clouds were slightly broken. Before 5 P.M. (standard time) a yellowish tinge began to be apparent. At 5.10 the color was reddish, and reached the horizon on all sides. At 5.20 the color was a deeper red, with clouds more broken. At 5.30 the clouds were thin, and showed faint but distinct blood-red color on the eastern horizon, though a little brighter in the west. At 5.40 the cloudiness was reduced to a partial thin film, but a dusky redness was still perceptible in all parts of the sky. At 5.55 the sky was everywhere thinly veiled, but a dark ruddy tint could still be faintly seen all around the horizon. At 6.10 the sky was mostly cloudless, though few stars were visible. A dark-red glow could be discerned in all parts of the heavens, and in the west it rose in broad, ill-defined bands from the position of the sun. At 6.20 no clouds, but only stars of first three or four magnitudes were visible. At first no ruddiness was seen, but shortly it became unmistakably apparent. It was a faint dusky red still obscurely barred in the west. This glow lasted two hours and eight minutes after sunset: atmosphere calm; thermometer sinking from 28° to 25° F. The observations possess interest in connection with similar ones recently made in various parts of the world. ALEXANDER WINCHELL.

Ann Arbor, Dec. 25, 1883.

Plant distribution in Lower California.

I would call attention to the fact, that many Arizonian, New Mexican, and Mexican species of plants, together with more northern species, are found on the narrow strip of tablelands in northern Lower California. Among them I may mention Quercus Emoryi and Q. pungens, Astragalus Sonorae, Fouquiera splendens, and many others, with Geranium caespitosum of the Rocky Mountains, Ivesia Baileyi of Nevada, Galium pubens, Quercus agrifolia, the common Pteris, Aquilegia truncata, and a number of introduced (?) species well known throughout the United States. CHARLES R. ORCUTT.

San Diego, Cal., Dec. 15.

Kames near Lansing, Mich.

A few years since, I spent one or two days at Mason, some ten miles south of Lansing, Mich. I had hoped to return at some future time, and complete my observations upon some peculiar ridges of sand, gravel, and bowlders in the vicinity of that village; but, as it may be some years before I shall be able to do so, I would like to lay the observations before the readers of *Science*, hoping that some of the Michigan readers may have time to investigate the subject fully.

The surface is here nearly plane. The front moraine of the Saginaw glacier lobe lies some thirty-five miles to the south-south-east, beyond Jackson. These ridges trend towards this moraine from some unknown point north of Mason to another unknown point ten or more miles south-south-east. I was informed that some of these ridges were six and eight miles in length, and are sometimes used as a highway. The drainage is to the northward at present, parallel with the course of the ridges, though I noticed one or two instances where creeks had intersected the ridges instead of being guided by them. The ridges seemed to persist in a northerly course, though with many local exceptions. I noticed one instance in which the main ridge turned nearly at an angle of 100°; but the main course was continued farther north in the heavier ridge, and at the elbow by a much lighter one. The ridges are quite variable in elevation. Perhaps the mean lies between twenty and thirty feet. The slope was not measured, but is, as a rule, too great to permit their being crossed by teams at the natural grade. The component material is all water-worn, and evidently deposited through the agency of water. The bowlders are of all sizes, up to twelve inches. Perhaps forty per cent were sandstone, similar in lithological characters to the subjacent rock strata. The remainder were metamorphic or igneous species, except some limestone pebbles.

Whether these ridges were formed in the longitudinal crevasses and river-channels of the ancient glacier, or not, must be determined by a more careful survey of the region than the writer was able to make in the few days spent at Mason. L. C. WOOSTER.

Eureka, Kan., Dec. 17, 1883.

Longevity in a fasting spider.

On the fifteenth day of October, 1881, I enclosed a spider in a small paper box. From that day to the seventh day of May, 1882 (204 days), I carefully watched and daily inspected the prisoner, and can positively affirm that he partook of no food or water. The box in which he was confined was as clean and white as white paper could make it, and remained so while he continued to occupy it, except for the appearance of a few dark specks which I suppose to be the droppings of the prisoner. I carefully observed him every day, and sometimes two or three times in a day; and I was unable to detect any emaciation or symptoms of weakness, or even irritability of temper, while he lived. He always appeared as active, and looked as plump and healthy, as he did the day I dropped him into the box, until within three days of his death, when I first observed that when the box was tipped he would fall from his position.

WILLIAM JONES, M.D.

Newburgh, N.Y.

The pedunculated lateral-line organs of Gastrostomus.

The recent discovery of a form of deep-sea fishes closely allied to the Eurypharynx described by M. Vaillant, by the U. S. fish-commission steamer Albatross, has afforded excellent opportunities for a more thorough examination of the external characters presented by the skin of these forms. This species of eurypharyngoid fishes, — the one studied by Professor Theodore Gill and myself, and named by us Gastrostomus Bairdii, — upon closer examination of the region of the lateral line, discloses features which appear to be somewhat remarkable, if not unique, amongst organs of the kind hitherto known.

The lateral line is in its usual position, and begins just behind the head. There is no mucous canal covering the end-organs; but these are isolated in groups of from two to five, standing on the skin in an oblique row at the hind margin of each muscular somite. The groups consist, in fact, of from two to five stalked organs, as shown in fig. 1 in the cut. The stalks are not pigmented at all, except at the tips, where they support a discoidal cup-shaped organ, which is more or less completely pigmented internally. In some instances these end-organs are very distinctly cup-shaped; in others that form is less clearly apparent. The base from which the stalks arise is not so deeply pigmented as the surrounding skin, which is very densely loaded with pigment, and very black. The pigment on the basal disks is, in fact, arranged in a slightly reticular manner: the pigmented layer is continuous with the outer clear sheaths of the stalks; and the medullary portion of the stalk can be seen in some cases to consist mainly of nerve-fibrils, which pass outwards to the cup-like organs at the tip. In a few cases there appears to be a clear space in the centre of the cup-like end-organ, as shown in fig. 2, surrounded by a dense circle of pigmented tissue.

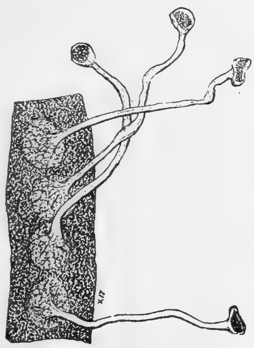


FIG. 1.

The function of these side-organs of Gastrostomus is apparently tactile, or may serve a special purpose at the great depth in which this fish lives. They remind one very forcibly of the rows of comb-like end-organs which have recently been described by F. Leydig on the head of the cave-fish (Amblyopsis spelaeus DeK.); but in this case the stalks are not so robust, and are much more slender, and relatively longer. It may even be that these lateral bands of side-organs of Gastrostomus are phosphorescent at their tips, like the side-organs of scopelids, steroptychids, etc. The lateral bands made up of short oblique rows of these organs, as the fish moves through the water at a depth of five to fifteen hundred fathoms, may possibly become luminous.

Fig. 2.

That they are also sensory in function there can be no doubt, being found in the usual position of the lateral line, as in common fishes, and, like it, probably innervated from the vagus. The stalks are fully a sixteenth of an inch long, and are apparent on the side when the fish is immersed in alcohol or water, and project outwards quite freely, so as to be visible along the sides when the fish is viewed from above. These naked side-organs remind one also somewhat of the naked nerve-hills on the sides of the body of young fishes, such as those of Gadus and Gambusia. In the former the stiff sensory hairs of the nerve-hills project immediately from the surface of the hill into the surrounding water, but in no embryo fishes am I aware that the side-organs are ever pedunculated. In fact, the side-organs of Gastrostomus Bairdii, like the whole of the rest of the organization of the animal, particularly its skull and branchial apparatus, present an extreme phase of specialization. J. A. RYDER.

RETROSPECT AND PROSPECT.

WITH the present number *Science* enters upon the second year of its existence. The time is an appropriate one, while extending a cordial greeting to its readers, to call their attention to its work and its purposes. That a journal of popular science, with the varied and informal contents appropriate to a weekly publication, would, if judiciously conducted, prove a welcome addition to the list of American periodicals, has long been felt by those most interested in scientific progress; but, when the numberless difficulties in the way of success had to be considered in detail, they were found to be numerous and perplexing. The general scope of the journal was the only feature about which little doubt could be felt. Two quite distinct yet inseparable objects of existence presented themselves: one was to keep the readers of the journal informed of the progress of science in all its branches; the other, to give expression to the well-matured views of scientific men upon all public questions connected with the increase of knowledge, and thus to become, so far as possible, an organ of public opinion upon scientific affairs.

In pursuing the latter object the path of duty was too plain to require discussion. The journal must be the organ of no individual, clique, or party, but must, while preserving entire impartiality, give plain and fearless expression to its convictions upon any question in which the interests of science at large were involved. How far it has fulfilled this requirement is a question to be decided by its readers and patrons, without argument from ourselves.

The question of the contents of the journal in detail was a far more intricate one. Shall its articles be designed exclusively for the specialist, or shall the results it makes known be popularized by the omission of all purely technical nomenclature? Shall they be long and elaborate, or short at the risk of incompleteness? Shall they be strictly and purely scien-

tific, or shall the speculative, sentimental, and poetic sides of things be allowed to appear? Shall its chronicles of progress consist of the briefest possible memoranda of all important current researches, each duly labelled for reference, or shall a selection be so made that each account shall be prepared with a statement of the origin, place, and object of the research, with a view of making its true significance known? In the case of scientific articles, where shall we draw the line between what belongs to this journal and what to those intended for the publication of original researches? These are merely a few of the more important questions which the projectors were obliged to meet, and which they have endeavored to decide in the way best fitted to give general satisfaction. The result is seen to a certain extent in the present number; but some aspects of the subject may be profitably considered from a broader field of view.

The difficulty arising from the technical nature of scientific researches admits of being partially resolved, so far at least as the general principle is concerned, by a very obvious consideration. Science must be almost as much popularized, to be made accessible to all scientific readers, as to be readable by the educated public who were never in a laboratory. A new formula in thermodynamics is as incomprehensible to a botanist as to a member of Congress. The average physicist knows as little about a brachiopod as the average merchant. What the most modest well-read clergyman may fairly think he knows about Darwinism far exceeds all that the common run of chemists really do know. The obvious conclusion is, that, should we seek to make discussions of current scientific researches accessible to all scientific readers, we cannot avoid being somewhat popular in style.

On the other hand, if the journal should present to its readers only that class of reading-matter which they get for nothing in the daily papers, its very existence would be a superfluity. To justify the publication of any periodical devoted to a specialty, it must present its readers with a kind of matter which they cannot find in the public prints.

The term 'popular science' is often made to include a class of discussions quite different from the presentation of scientific truths in common language. Science at the present day is the ideal of democracy. Its work and its honors, from the highest to the lowest, are thrown open, without restriction, to all men. There is no authority which can say to the humblest worker, "I know this, and you do not: I am therefore above your criticism, and you must accept my statements without essaying to inquire into the validity of their foundation or the soundness of their application." There is no tribunal in the scientific world which has the power to proclaim what is and what is not proved; what problems are and what are not solved. To one who has never considered this state of things, the first impression felt is, that it must imply universal anarchy; that in a community where every one has equal authority — that is, no authority at all — there can be no such thing as permanent and widely received opinions. But the very opposite is the truth. A system which requires every doctrine to stand on its own merits, and to maintain itself only by being proof against every assault, is the very one under which truth stands the best chance of showing its permanency. A long-established scientific doctrine stands like the Matterhorn, not through being protected from assault, but by being able to resist the storms of ages.

Now, there is in every civilized country a class of writers who avail themselves of this principle of equality to discuss subjects of which they have no accurate knowledge, to propound new theories, and to attack old ones. A voluminous literature thus arises which is the work of the lay element in the scientific community, and which is therefore sometimes called popular science. Such productions must stand on their merits as much as the propositions of the professional scientific man, and are entitled to consideration only according to their merit. The policy of *Science* is to admit nothing to its pages which does not belong to the domain of knowledge, excluding with especial care speculations upon subjects like the nebular hypothesis in which many active minds are so fond of indulging.

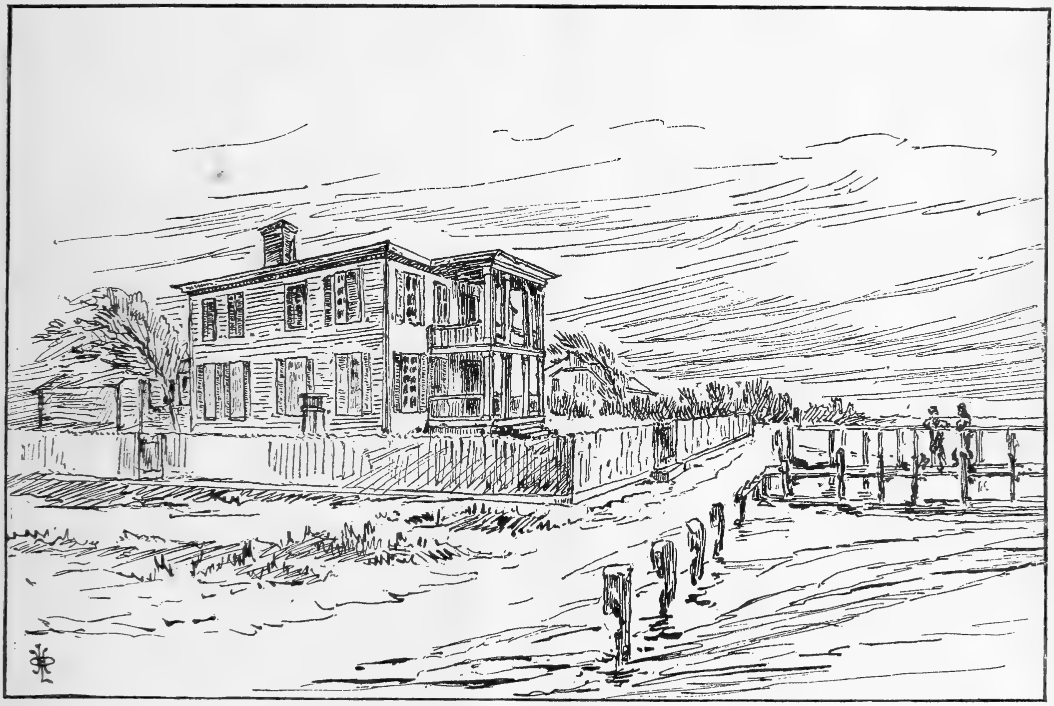
After a careful consideration of the form in which the results of current researches should be presented, it has been decided to substitute for the weekly summary heretofore presented brief discussions of current work which shall be of more interest to the general reader. To combine brevity with perspicuity in such cases is often a very difficult problem, in which the golden mean affords the only solution.

The form in which *Science* is now presented has been to a large extent the result of careful inquiry among its accessible friends and patrons. Manifestly, the plan in view cannot be developed in a single number; but we hope that a few weeks will show our purpose to make *Science* of greater value than heretofore to our widening circle of readers.

THE MARINE LABORATORY OF THE JOHNS HOPKINS UNIVERSITY.

THE Chesapeake zoölogical laboratory was instituted by the trustees of the Johns Hopkins university as part of the biological department of that university in 1878, and Dr. W. K. Brooks was appointed director. Its purpose is twofold, — to furnish complete facilities for original studies in marine zoölogy, and a place for more elementary instruction. The fauna of the southern waters of the United States was selected for study. In providing thus a place for advanced work, this university has taken the initiative among American colleges; the various summer schools held along our coast being more particularly concerned in instruction than in investigation of new problems. The first and second sessions in 1878 and 1879 were held in the lower parts of the Chesapeake Bay. In 1880 the laboratory was moved to Beaufort, N.C.

Beaufort has been a favorite haunt of naturalists ever since 1860, when it was visited by Drs. Stimpson and Gill. No better place could be selected for the study of the forms of life in southern waters. It lies at the mouth of Old Topsail Inlet, ten miles west from Cape Lookout, protected from the ocean, except in its worst moods, by a broad sand-bar, and yet so near that an hour's sail carries one out upon the high seas. Owing to the configuration of the coast-line, the warm Florida current flows by and almost bathes the shore. This warm current, setting up from the shores of the Gulf, sweeps along with it many pelagic animals which belong to a hotter climate. Yet, while the ocean-life is decidedly southern, the climate of Beaufort is not oppressive : indeed, the place and its neighbor, Morehead City, are summer resorts. The town, standing almost in the ocean, is swept by nearly constant breezes, which temper the heats of July and August.



MARINE LABORATORY AT BEAUFORT.

The place is quite accessible, being only two miles from Morehead City, the eastern terminus of the North Carolina midland railway, and may be reached by steamer from Norfolk *viâ* Newberne, and by rail from points north and west *viâ* Goldsboro.

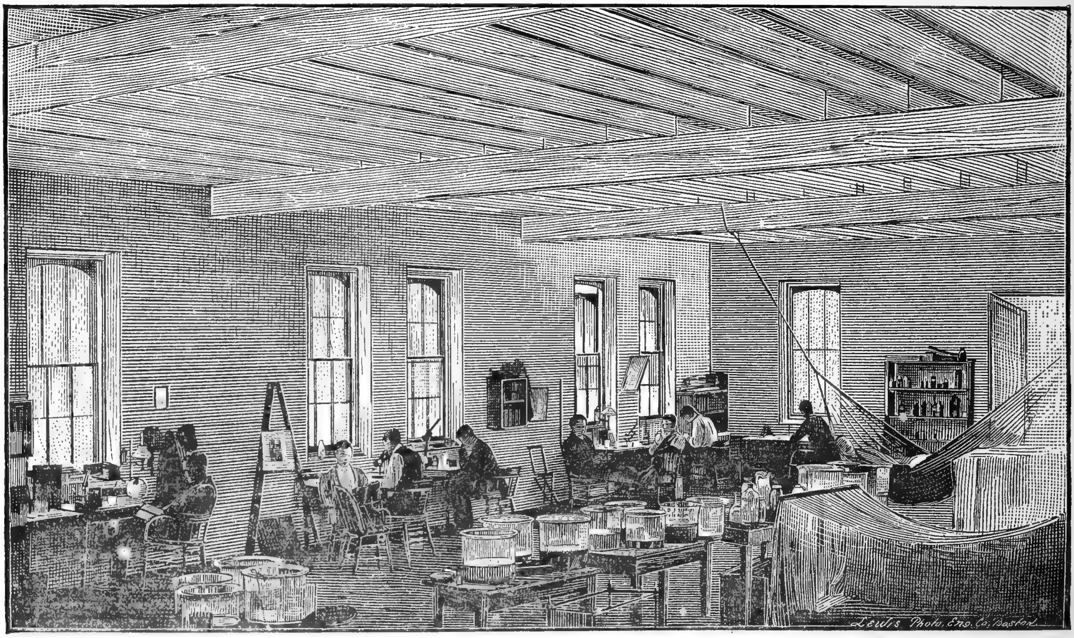
The site of the laboratory at Beaufort is most convenient, being at the very water's edge. A pier built out from the front gate to the deep water crosses a flat of black soft mud, bare at every low tide, and a place where the

specimen hunter is richly rewarded. A search here obtains for one crabs and hermits, Porcellana in tubes with Chaetoptorus, Alpheus, annelids, mollusks, echinoderms, ascidians, and barnacles upon the wharf-piles. The general student can here find material to illustrate his study of almost any of the larger groups literally within a stone's throw of his work-room. From the end of the wharf at high water the dip-net secures not only quantities of things to interest the general student, but crustacea, medusae, Sagitta, and larvae of the greatest interest to the specialist.

Across the channel which runs along the water-front is a large sand-shoal, uncovered during several hours every day; and here are the favorite haunts of myriads of interesting creatures. I say myriads advisedly, for one of the most striking features of the Beaufort fauna is the extreme abundance of almost all the forms which occur there at all. The inner side of this shoal is literally honeycombed by a colossal species of Balanoglossus often three feet long; and on the outer edge are to be found Mellita in great numbers, and dead shells of Mellita inhabited by Thallasema, as many as one has the patience to collect. All over the shoal creep Limulus. In the deeper water just off the shoal are Renillas without limit and the beautiful nudibranch Pleurophyllidia.

Trawling in the sound procures starfish, echinoids and ophiurans, Chiton, Fissurella, Leptogorgia, Astrangia, often with large masses of coral. High tides sweep in pteropods, Sagitta, Leucifer, Siphonophora, pelagic larvae, and medusae of great interest, such as Liriope and Cunina. The rocks upon the artificial breakwater furnish Penophora, tubularian hydroids, and several species of actinians. On shells inshore are found the known genera of entoproctan Bryozoa.

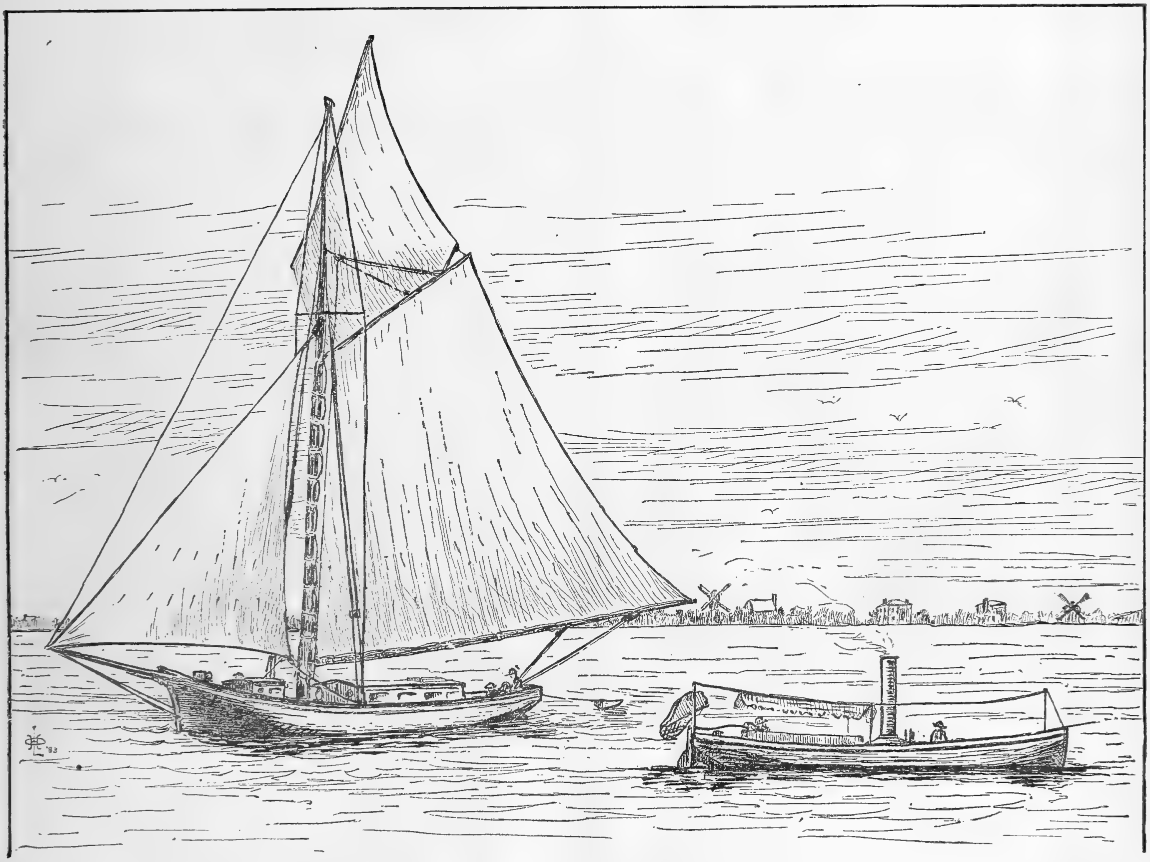
But I cannot give a complete list of the fauna here, nor even mention all the attractions. I have not tried to do so, but merely to intimate the exceeding variety and abundance of forms of the greatest interest. Though Beaufort has been the resort of naturalists for the last twenty-five years, it has not yet been to any degree exhausted.



INTERIOR OF MARINE LABORATORY AT BEAUFORT.

Since Beaufort was felt to be a somewhat transient location for the laboratory, a permanent building, with all the modern conveniences for work, was not erected. A two-storied double house, with eight rooms, was rented for work-room; and houses adjoining were secured as living-quarters for the party. Thus, both in their work and in the life out of the shop, the party was kept pretty well together; and the members had that opportunity of forming personal acquaintance with one another, the

value of which does not require comment. The furnishing of the building was simple, — tiled tables, with lights only; and other luxuries were dispensed with. Not even were pumps erected to maintain a constantly renewed stream of salt water circulating through the aquaria. In their place was used the cheaper and very effective device of aeration by means of a stream of fresh air constantly forced through the aquaria by a Sprengel pump.



YACHT AND STEAM-LAUNCH OF JOHNS HOPKINS MARINE LABORATORY.

Facilities for work were not, however, in the least curtailed; and all the apparatus for capture and means for getting about were provided. The dredge and trawl, spade and sieves for bottom fauna, towing and dipping nets of silk bolting-cloth for surface forms, and many special traps devised for the capture of particular animals, formed a complete array of appliances. Besides its small boats, the laboratory has for several years possessed a steam-launch of Herreschoff pattern, twenty-seven feet long, and with a draught of about thirty inches, capable of taking us to any points about the sounds and rivers, or even of venturing out to sea when Old Prob did not menace with danger-signals. The launch was most useful, and was in service almost every day for dredging, trawling, or carrying parties out to tow in the open ocean. She is, however, but a passing stage, as her name Nauplius implies; and we hope some day to possess a full-grown steam-vessel, in which we can with safety explore the deeper waters offshore, which are as yet almost entirely unstudied.

During the past summer the navy has received an important addition in the form of a yacht, to be called the Zoea, though at present otherwise registered. She is a full-rigged sloop, forty-seven feet long, fifteen feet beam. She won a silver cup in a regatta upon the Potomac while in her former service, and her speed was a pleasant feature of collecting-trips

in her. Her sailing qualities do not at all unfit her for our work. Her cabin has ample accommodations for four persons, and could stow eight; and the cuddy forward has room and all the utensils for the cook: so that cruises to a distant dredging-ground can be undertaken without inconvenience, by a fair-sized party.

Of the usefulness of the Chesapeake zoölogical laboratory we may feel assured, though it is still in its infancy. It has held six sessions. During that time there has been a total attendance of fifty, of whom fourteen have been in attendance at least two sessions. These fifty men have been gathered from more than twelve different colleges, and are at present located in fourteen different states, besides two who came from Canada, one from Cambridge, Eng., and one from Japan.

In 1879 the laboratory was in co-operation with the Maryland fish-commission; and Dr. Brooks devoted most of his own time during the season to a study of the oyster, with especial reference to its embryology and its artificial propagation. The theoretical results of his work are of the greatest significance; but he succeeded in artificially fertilizing the oyster's eggs, and shedding such light upon the habits of reproduction that the greatest interest was aroused, and zeal in the search for some practicable method of oyster-culture, to replenish the waning oyster-beds. This interest has resulted in the discovery of a practicable method.

I will not recapitulate all the scientific papers published as resulting from work done in the laboratory: suffice it to say, that important memoirs have been published upon Lingula, Squilla, Leucifer, Renilla (the last two being published in the *Philosophical transactions* of the Royal society), Thallasema, and a monograph, not yet complete, of the Hydromedusae of the south coast. Beside these memoirs, the various members of the laboratory have written numerous shorter papers, which have been published in the *Quarterly journal of microscopical science*, the university *Studies*, and Carus's *Zoologischer anzeiger*. These articles, embodying the results of the laboratory's work, number, in all, fifty-nine separate titles.

For the most part, the laboratory has been morphological in the aspect of its work; not exclusively so, however, for both in 1881 and 1883 Dr. Sewall worked there upon selachians with reference to the equilibrium-sense function of the semicircular canals.

Last summer (1883), after three years at Beaufort, the laboratory was moved back to the Chesapeake Bay, and located in a building rented from the Hampton normal school. The location was in many respects not a good one, for it was far away from the best collecting-grounds and supplies of pure salt water; but it was selected to permit the laboratory to co-operate with the Maryland state oyster commission in experiments upon artificial propagation, and other expedients for a rapid and reliable method of restocking the oyster-beds in Chesapeake Bay. Lieut. Winslow, U.S.N., detailed for special service, was with us during most of the summer; and in the early part of the season the oyster-police boat, Gov. Hamilton, was stationed at the lower end of the bay.

The results of the season's work are not yet so far worked up as to permit one to speak about them. We had among us Mr. William Bateson of Cambridge, Eng., who came over to work upon Balanoglossus. His work includes a more thorough knowledge of the larval history of Balanoglossus than has been hitherto attained, and promises much that will be of greatest interest in respect to that most problematical creature. Henry L. Osborn.

THE DETERMINATION OF THE OHM.

The importance of having a uniform standard of electrical resistance is so apparent, that the establishment of a unit which shall be suitable for practical work, and will also satisfy the demands of electrical science, has for a number of years been regarded by all electricians as of the first importance.

The requirements of such a standard are, that it shall be easily reproduced or verified; that it shall have a simple relation to the units of work, heat, etc., and therefore be based on the fundamental units of length and time; and, finally, that it shall be of so great resistance as to be suitable for all ordinary practical work.

In the year 1862 the British association decided that a unit of resistance based simply on the earth quadrant, or ten million metres, as the unit of length, and the second as the unit of time, would be of such a magnitude as to best satisfy the requirements of the case. Experiments were then undertaken by a committee of the British association with a view to the construction of standards which should accurately represent this unit of resistance, or *ohm* as it was called. Owing to some minor defects in experimentation, and to an unaccountable error in the determination of the coefficient of self-induction of the revolving coil, their result was in error. This standard British association unit, as it is now called, is confessedly too small; but it is the basis of the

so-called ohm-coils that are in current use. The latest experiments indicate that the value of the British association unit is .9867 ohms; this result having been obtained by Lord Rayleigh by two distinct methods, and by Mr. Glazebrook by still another method. But different observers still differ quite widely in their results.

The International committee on electrical units, which met in November, 1882, in Paris, in view of the present unsettled state of the case, and the necessity for the speedy adoption of a suitable standard, decided that when the length of a column of pure mercury of one square millimetre section, and having a resistance of one ohm, shall have been determined to within one part in a thousand, the ohm shall then be defined as the resistance of such a column of pure mercury of the determined length; and the different governments represented were urged to prosecute experiments for the accurate determination of this length. For this purpose, among others, an appropriation of twelve thousand five hundred dollars was made by the last Congress of the United States. The work on the unit of resistance is under the charge of Professor Rowland of the Johns Hopkins university; and the experiments are being carried on in Baltimore, both at the university and at Clifton Park, two miles from the city. Owing to some unexpected delays in the construction of necessary apparatus, the work that has been undertaken first is the determination of the specific resistance of mercury in British association units. This has been experimented upon by measuring the resistance of columns of pure mercury contained in glass tubes of various calibers and lengths, so that the resistances of the columns experimented upon range from one to ten British association units. The remaining part of the work is the determination in ohms of the resistance of the British association standard used in this determination of the specific resistance of mercury. Two principal methods will be employed for this purpose.

First, the resistance will be found by means of the mechanical equivalent of heat. The apparatus used by Professor Rowland, in his well-known work on that subject, has been set up for this purpose. It is proposed to heat some non-conducting liquid, such as alcohol or turpentine, by means of the heat developed by the passage of the current of electricity in a conductor whose extremities are kept at a known difference of potential. The same heating will then be produced, under the same circumstances, by purely mechanical means; and the resistance of the conductor will thus be determined directly from the work-equivalent of the heat developed in the conductor.

The second method to be used is that of Kirchoff, as modified by Rowland in his determination of the ohm in 1876. The instruments will, however, be in large part new, and constructed expressly for this research; so that a new set of instrumental constants will be involved. A third method, the earth-inductor method of Weber, will also be used if time permits.

For these experiments it is proposed to use, as a source of electricity in the calorimetric method, fifty Planté cells charged by a small dynamo machine. For measuring large currents of electricity an electrodynamometer has been constructed, with the Helmholtz arrangement of two large coils and a single small suspended coil. The diameter of the large coils is about one metre: that of the small suspended coil is about twenty-five centimetres. There are two sets of large coils, — one wound with large wire, about no. 8; and the other with much smaller, about no. 15. There are also two small suspended coils wound to correspond. This arrangement gives the instrument great power and range. The divided circle was made by Fauth & Co. expressly for this instrument. Four induction-coils are to be wound in four parallel equidistant grooves, turned on the outside of a brass cylinder about one metre in diameter. These coils will each consist of about two hundred turns of no. 15 copper wire. This arrangement will afford great variety in the manner in which the several coils may be combined; for the inductive action of each coil upon each of the others may be taken, giving three simple combinations for each coil.

The trustees of the Johns Hopkins university have kindly placed the Clifton House at Professor Rowland's disposal for the conduct of these experiments; and, as it stands in extensive grounds at a considerable distance from the road, it will be peculiarly suitable for delicate electrical experiments. Piers have been built for the different instruments, and a small steam-engine set up for supplying the power necessary for running the dynamo machine and the mechanical equivalent of heat apparatus. The actual experimentation will be carried on, under Professor Rowland's direction, by A. L. Kimball, assisted by H. R. Goodnow and Ensign Louis Duncan, U.S.N.; the latter having been specially detailed for the work by the Navy department.

It is hoped that a satisfactory conclusion will be reached by September, 1884.

PECULIARITIES OF WEATHERING IN THE POTTSVILLE CONGLOMERATE.

THE striking characteristics of the Pottsville conglomerate in eastern Pennsylvania are its highly siliceous composition and its solidity. Owing to a consequent great durability, it stands out prominently along the different mountain ridges which surround the anthracite coal-basins; but though, as compared with the associated rocks, its resistance to weathering is very great, the effects of this action are everywhere revealed on examination.

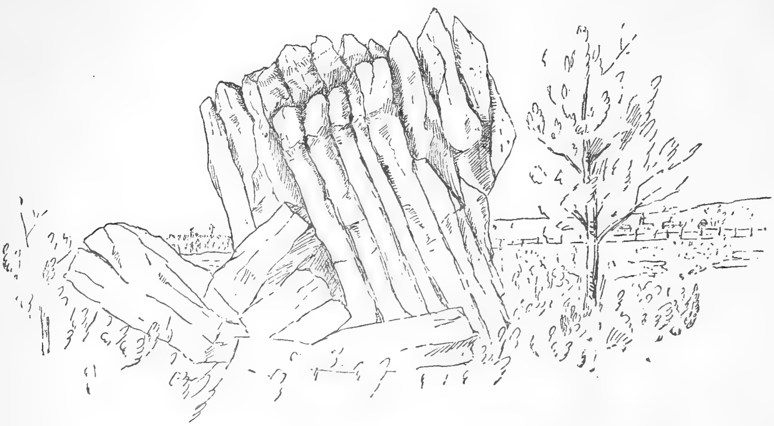


FIG. 1.—Outcrop showing weathering along the plane of stratification.

The surfaces of the finer and more compact varieties are frequently seen to be covered with numerous small holes, or pit-marks, resulting from the removal of separate grains. Blocks of the coarse pudding-stone have generally a very rough surface, the pebbles projecting half their thicknesses above the surrounding matrix; and fragments of this rock are sometimes so thoroughly permeated and softened by percolating water that they can be crushed to grains by the hand.

Along the planes of stratification the subaerial decay of this rock is particularly well marked. Deep clefts and gashes are found along these planes, which frequently cut entirely across large masses, dividing them into separate slabs. This action is best developed along the upturned edges of steeply inclined dips, where water has the best opportunity to accumulate and to prolong its action in incipient grooves; and, with isolated blocks only slightly inclined, the increased decay along the upturned edges, due to this same cause, is often noticeable. A somewhat remarkable fact about such weathering is, that clefts parallel to the stratification are found in an apparently homogeneous rock. In such cases a difference or deficiency of cementing-material must be the directing cause.

Weathering action across the plane of stratification is exhibited in its first stages by shallow and narrow grooves, which run sinuously across the rock. These have their origin in little streams of rain-water which flow from the surface down the sides of the rock. Once started, such a groove forms a channel whose drainage capacity constantly increases as the depression enlarges; and by degrees the fine groove grows to a decided fissure, half a foot or more across, which the continued action of rain-water cuts deeper and deeper into the rock. This fissure is generally of approximately uniform breadth; but, as it enters farther into the rock, the water drains into it from all sides, and an enlargement is sometimes formed at the end, which I have seen to result in an almost circular hole, completely penetrating the rock.

The most peculiar and remarkable of all the results of this weathering action are, however, those produced by a superficial action in the plane of stratification. Over flat surfaces of the rock, white, washed-looking patches occur; but where a slight depression exists, the water

FIG. 2.—Isolated conglomerate mass showing increase of weathering along the planes of stratification on the upturned edge.

accumulates and stands, and as a consequence the grains of the rock in immediate contact are loosened, and, on the evaporation of the water, blown away. Thus the depressions which were at first, perhaps, only a fraction of an inch, are deepened, and, by degrees, basins of as much as a foot in depth are eaten out. These are often so regular in outline, and with such smooth sides, that they might readily be mistaken for pot-holes; and, indeed, it was such that I first considered them, and was puzzled to account for the peculiar channel in which the waters producing them must have flown. A distinguishing feature of these depressions, however, is that each one has an outlet cut down to near the bottom of the cavity; and this is easily accounted for, on the theory of their subaerial origin, by considering, that, once such a basin started, the overflow would always pass off over the lowest edge, and as the basin increased in depth, by continued dissolving action, so would the outlet also. A further confirmation of this is furnished by the facts, that in inclined rocks the outlet is always towards the lower rim, and the bottom of these cavities is either horizontal or sloping towards the outlet. In the bottom is also generally accumulated a small amount of gravel and sand recently loosened from the bed. These basins are of all sizes, up to three feet

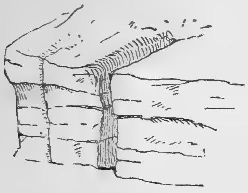


FIG. 3. — Weathering across the plane of stratification.

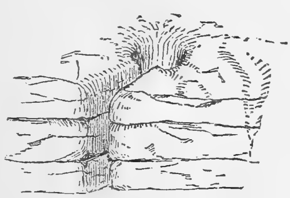


FIG. 4. — Enlargement at end of fissure.

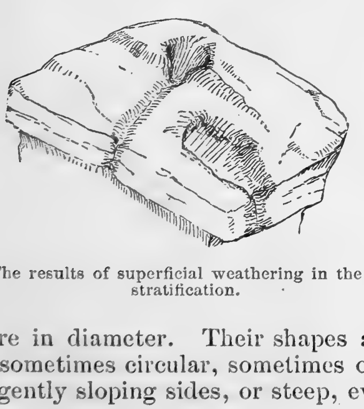


FIG. 5. — The results of superficial weathering in the plane of stratification.

and more in diameter. Their shapes are varied, — sometimes circular, sometimes oblong, — with gently sloping sides, or steep, even recurving ones, according to the character of the rock. They are frequently connected in strings by narrow channels, like a miniature lake system; and, with the enlargement of these channels, a simple, deep groove across the rock results, all this action combining to give the rock a very rugged appearance.

The very preponderance of silica grains in this rock, to the exclusion of any good cementing-material, is probably one of the chief reasons for its decay. Rain-water is, without doubt, one of the most active agents; but the secretions from the thick growth of moss and lichens, which frequently covers the surface and penetrates into the cavities of the rock, have probably also their effects. The deep gashes produced by the action of the rain-water offer excellent opportunities for frost to continue the work of destruction; the ice forming in these clefts, and, by its prying action, completing the separation of the already partially divided mass.

As a consequence of this wide-spread weathering process, large continuous outcrops are rarely found. Collections of huge blocks generally mark their site; and the thick accumulations of smaller fragments, which are so frequently found over conglomerate areas,

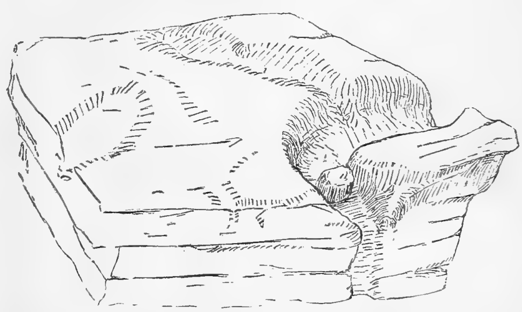


FIG. 6. — Large basin in conglomerate, with a double outlet.

result, without doubt, from the further subdivision of these larger blocks.

The products of decay either accumulate in place, are washed down by streams, or blown away by the wind. On the top of Broad Mountain, and elsewhere, the disintegration *in situ*, I am informed, is so great that the loose rock is dug out as gravel; and, in valleys watered by streams flowing down from conglomerate ridges, deep deposits of siliceous sand are found, valuable for building-purposes.

The decay of the sandstones and shales, associated with or underlying the conglomerate, is even more pronounced than in that rock. Changes of color, especially from the greenish tints to red, brown, and yellow, are the most

frequent results; and this is often accompanied by a softening to a barely coherent sand or clay. Erroneous conclusions are thus frequently drawn from surface indications, as to the nature of the underlying rock.

The subject of the decay of rocks has recently been admirably treated by Dr. T. Sterry Hunt,[1] chiefly with regard to the crystalline rocks; and it deserves to be further studied, in the case of these more recent rocks, from its evident importance in chemical geology, its interesting and well-known relation to topography, and its economic bearing. ARTHUR WINSLOW.

Pennsylvania geological survey.

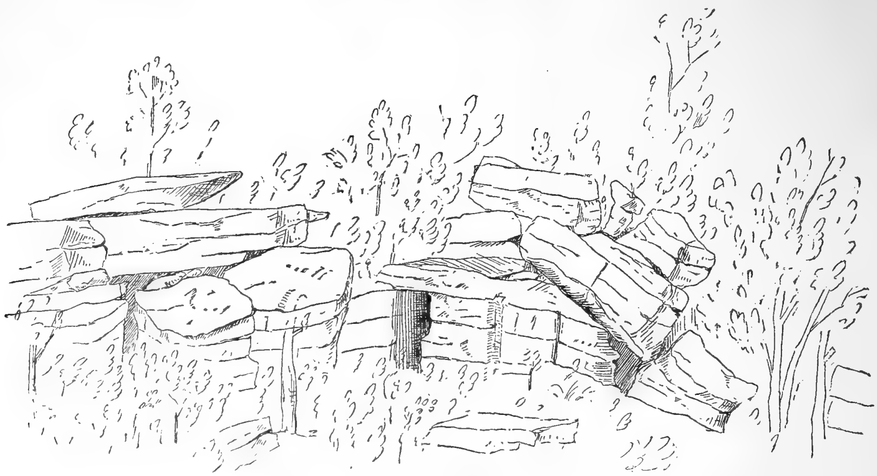


FIG. 7. — Broken conglomerate outcrop.

ELECTRIC LIGHT TESTS AT THE LOUISVILLE EXPOSITION.

THE display of electric lights at the Louisville exposition, as to number, was the greatest ever made in and around one building. The number of lights used varied somewhat, but the average was about as follows: —

	Incandescent lights.	Arc-lights.
Edison isolated lighting company . .	4,600	–
U. S. electric light company	210	29
Fort Wayne Jenney electric light company	–	100
Thomson Houston electric light company	–	36

The jury — consisting of Benjamin Rankin, Louisville; W. W. Weaver, Chicago; Charles Smith, J. A. Tanner, M.D., and H. W. Eaton, Ph.D., Louisville — was not appointed till about three weeks before the close of the exposition: hence thorough tests were impossible.

As the U. S. company did not enter into the contest, there was no competition on the incandescent lights. However, the following tests were made: connection was made with a circuit containing 315 lights at what was considered an average point in the circuit; and fifteen lamps, five of them new and the balance selected systematically from the circuit while lighted, were tested in a specially constructed photometer-room while indicator-cards were being taken from the engine.

A Bunsen photometer with a twelve-foot bar was used, and the horizontal intensity determined with the carbon at an angle of 45°. The intensity of the (nominally) 16-candle lights varied from 12 to 19.66 candles, averaging 13.77 candles; and the average horse-power was 32.50. These figures give 9.70 lights, or 133.57 candles, per mechanical horse-power.

The action of the automatic regulator was then tested with a light in the photometer, first 50 and then 100 lights being thrown off and on. In one of the six cases the variation was 1.23 candles, but in all the others it was less than .66 of a candle. Only a momentary flicker was noticed as the lights were thrown off and on.

The jury reported as follows: "The tests of the Edison system are most satisfactory as to the efficiency of the various appliances, the steadiness of the light produced, and the general results. It is a matter worthy of note, that

[1] The decay of rocks geologically considered. By T. Sterry Hunt, LL.D., F.R.S. *American journal of science*, September, 1883.

during the 100 days of the exposition, with over 4,000 lights burning, there was not at any time a suspension of light from failure of the appliances of the Edison electric lighting company."

Of the arc-lights, lamps were chosen, one at a time, from the circuits, and inserted in the same circuit in the photometer-room, care being taken that no change was made in the circuit adjustments. Indicator-cards were taken from the engine used, during the testing of each lamp. The strength of current, and fall in electromotive force, were also determined with an amperemeter and voltmeter; but, as only relative results were desired, these instruments were not graduated.

The photometer-bar was fifty feet long; and tests showed that there was no reflection vitiating the results, from the dead-black surface of the walls of the room. The photometric tests were made with an Edison incandescent light as a standard. Fifteen tests from candle to incandescent, and ten from incandescent to arc lights, were made for each lamp, five arc-light tests being between the same number of tests of the standard.

The arc-light was cut out during the tests of the standard, and a new cup was allowed to form before the next set of tests was made.

The dynamos were worked to their full advertised capacity in regard to the number of lights in the circuits; and four lights were tested in each case, with the following results: —

	Jenney.	Thomson Houston.
Total number of lights in circuit	16	12
Total mechanical horse-power	26.92	11.79
Average horizontal intensity in candles .	496.5	291.8
Average intensity per horse-power . . .	306.5	296.9
Relative efficiency of lamps from light, current, and fall in electromotive force .	1.055	1

From these tests, and an examination of the dynamos, lamps, regulators, etc., the awards were made as follows: to the Edison company, for isolated lighting, medals for the best incandescent system and light, and for the best dynamo and lamp for the incandescent light; to the Fort Wayne Jenney electric lighting company, medals for the best system and dynamo for arc-lighting; but, to the Thomson Houston electric lighting company, a medal for the best arc-light, because, "while the light of the Jenney was slightly stronger per horse-power of electrical energy used in the lamp, it was not quite so steady as the Thomson Houston."

H. W. EATON.

THE LATE MR. DARWIN ON INSTINCT.[1]

AT the meeting of the Linnean society this evening (Dec. 6) a highly interesting posthumous paper on Instinct, by Charles Darwin, will be read and discussed. We have been favored with an early abstract of the same, which we here present to our readers.

After detailing sundry facts with reference to the migratory instincts of different animals, Mr. Darwin proceeds to suggest a theory to account for them. This theory is precisely the same as that which was subsequently and independently enunciated by Mr. Wallace in *Nature*, vol. x. p. 459. Thus, to quote from the essay: "During the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still I can well believe that the impulse [originally due to seeking food] which leads the pinioned goose to scramble northward would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals (and savage men) can retain a true course, it would safely cross the sea now covering the submerged path of its ancient journey."

The next topic considered is that of instinctive fear. Many facts are given showing the gradual acquisition of such instinctive fear, or hereditary dread, of man, during the period of human observation. These facts led Mr. Darwin to consider the instinct of feigning death, as shown by sundry species of animals, when in the presence of danger. Seeing that 'death is an unknown state to each living creature,' this seemed to him 'a remarkable instinct:' and accordingly he tried a number of experiments upon the subject with insects, which proved that in no one case did the attitude in which the animal 'feigned death' resemble that in which the animal really died; so that the instinct really amounts to nothing else, in the case of insects at all events, than an instinct to remain motionless, and therefore inconspicuous, in the presence of danger. From the facts given with regard to certain vertebrated animals, however, it is doubtful how far this explanation can be applied to them.

A large part of the essay is devoted to 'Nidification and habitation,' with the object of showing, by an accumulation of facts, that the complex instincts of nest-building in birds and of constructing various kinds of habitations by mammals, all probably arose by gradual stages under the directing influence of natural selection.

The essay concludes with a number of 'miscellaneous remarks' on instincts in general. First the variability of instinct is proved by sundry examples; next the fact of double instincts occurring in the same species; after which, "as there is often much difficulty in imagining how an instinct could first have arisen," it is thought "worth while to give a few out of many cases of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, give rise to

[1] From *Nature* of Dec. 6.

such." Finally, cases of special difficulty are dealt with. These may be classified under the following heads: 1. Similar instincts in unallied animals; 2. Dissimilar instincts in allied animals; 3. Instincts apparently detrimental to the species which exhibit them; 4. Instincts performed only once during the lifetime of an animal; 5. Instincts of a trifling or useless character; 6. Special difficulties connected with the instinct of migration; 7. Sundry other instincts presenting more or less difficulty to the theory of natural selection.

The 'conclusion' gives a summary of the general principles which have been set forth by the whole essay. This, therefore, we shall quote *in extenso*: —

"We have in this chapter chiefly considered the instincts of animals under the point of view whether it is possible that they could have been acquired through the means indicated on our theory, or whether, even if the simpler ones could have been thus acquired, others are so complex and wonderful that they must have been specially endowed, and thus overthrow the theory. Bearing in mind the facts given on the acquirement, through the selection of self-originating tricks or modification of instinct, or through training and habit aided in some slight degree by imitation, of hereditary actions and dispositions in our domesticated animals, and their parallelism (subject to having less time) to the instincts of animals in a state of nature; bearing in mind that in a state of nature instincts do certainly vary in some slight degree; bearing in mind how very generally we find in allied but distinct animals a gradation in the more complex instincts, which shows that it is at least possible that a complex instinct might have been acquired by successive steps, and which, moreover, generally indicates, according to our theory, the actual steps by which the instinct has been acquired, inasmuch as we suppose allied instincts to have branched off at different stages of descent from a common ancestor, and therefore to have retained, more or less unaltered, the instincts of the several lineal ancestral forms of any one species, — bearing all this in mind, together with the certainty that instincts are as important to an animal as their generally correlated structures, and that in the struggle for life under changing conditions slight modifications of instinct could hardly fail occasionally to be profitable to individuals, I can see no overwhelming difficulty on our theory. Even in the most marvellous instinct known, that of the cells of the hive-bee, we have seen how a simple instinctive action may lead to results which fill the mind with astonishment.

"Moreover, it seems to me that the very general fact of the gradation of complexity of instincts within the limits of the same group of animals, and likewise the fact of two allied species placed in two distant parts of the world and surrounded by wholly different conditions of life, still having very much in common in their instincts, support our theory of descent, for they are explained by it; whereas, if we look at each instinct as specially endowed, we can only say that it is so. The imperfections and mistakes of instinct on our theory cease to be surprising: indeed, it would be wonderful that far more numerous and flagrant cases could not be detected, if it were not that a species which has failed to become modified and so far perfected in its instincts that it could continue struggling with the co-inhabitants of the same region, would simply add one more to the myriads which have become extinct.

"It may not be logical, but to my imagination it is far more satisfactory, to look at the young cuckoo ejecting its foster-brothers, ants making slaves, the larvae of the Ichneumonidae feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies, — Multiply, vary; let the strongest live and the weakest die."

DR. GRINEWETZKY'S CROSSING OF NOVAIA ZEMLIA.

On the $\frac{1}{14}$ November, Dr. Grinewetzky described, before the Geographical society of St. Petersburg, his travels on this island. He first started on foot on the $\frac{5}{17}$ August, with Kriwoskeya and a Samoyede (a few of whom are found near Karmakuly). The weather was beautiful, the thermometer 5° C.; but soon after reaching a mountain with a very extensive view, where they passed the night, they were overtaken by a violent snow-storm, and compelled to return. In April, 1883, the Samoyede Hametz crossed the island to the south-east coast, and found Samoyede *chums* (tents). Hearing of this, Grinewetzky, accompanied by Hametz and another Samoyede, set out in sleds drawn by dogs. They had scarcely any food for the dogs, but were assured they would find plenty, as wild reindeer were abundant. This proved not to be the case; and on the fifth day the poor dogs were near starving, when a large herd of reindeer was met. Many shots were fired without effect, due to the difficulty of seeing distinctly, as the men's eyes were much affected by the reflected sunlight, and, in addition, their hands were benumbed by the cold (— 20° to — 25° C.). At last two were killed, and the dogs saved. At first a number of very steep parallel ridges, principally of black slate, were encountered. At some places, hard and exceedingly steep snowdrifts had to be avoided by ascending the surrounding hills. Excepting these drifts, there was but little snow, as, if loose, it was swept away by the strong east-south-east wind prevailing. After the watershed between the west and east coasts is passed, the country becomes a low plateau, and the snow softer and rather deep and regular. On the $\frac{30\text{ April}}{12\text{ May}}$, with the temperature at — 27° C., they prepared to return, as they had already proceeded two days farther than was intended, and no chums were in sight; and, although one of the Samoyedes said the chums were only three miles distant, they began the return.

This expedition is important as the first crossing of Novaia Zemlia by civilized man. According to information collected by Tjagin (1878–79), Pakhtus-

sow, Ziwolka, and Moisseew (1832–39), and a few notes by Höfer and Nordenskiöld, and from his own observations, Grinewetzky gives the following sketch of the south island of Novaia Zemlia. It may be divided into three parts. The northern lies between Matotschkin Shar on the north and the Pukowaja River on the south: this part has the highest mountains (four thousand feet), forming isolated groups rather than ranges. The central part, extending to the Karelka and Belushia Rivers, has five or six parallel ridges, running generally north and south; black slate is common; and the watershed is about seventeen miles from the west coast. The southern part is a rather low plateau: the Goose Land (Gusiwaya Zemlia) is included in this part, which is free from snow by the end of June, and in July has a rather rich vegetation, especially on the gently sloping ground.

Dr. Grinewetzky also expressed the opinion that the wild reindeer of the northern island belong to a totally distinct sub-species from those of the southern island.

LOSS OF NITROGEN FROM ARABLE SOILS.

The renewed attention of agriculturists has of late been drawn to the question of the nitrogen supply of cultivated soils. On the one hand, Schulz, in Germany, claims to have brought about a gain of nitrogen on a sandy soil by means of the cultivation of lupines, and manuring with kainit. On the other hand, Lawes, Gilbert, and Warington,[1] in England, have published results which show that a very considerable annual loss of nitrogen occurs in the drain-water of cultivated fields; and experiments by Dehérain,[2] in France, show, according to his interpretation of them, an alarming decrease in the total nitrogen of the soil in the course of a few years, and in spite of abundant manuring.

Schulz's experiments have added nothing to our knowledge of the natural supply of nitrogen to the soil, and it is not proposed to consider that topic here. The results of Lawes, Gilbert, and Warington, and of Dehérain, however, have attracted much attention. If they are to be accepted without reserve, they lead to the conclusion that the fertility of our cultivated fields, so far as it depends upon their nitrogen, is being removed in the drainage-water, or in other ways, at a comparatively rapid rate.

The instigation to Lawes, Gilbert, and Warington's experiments was given by the observation, that, in the field-experiments carried on for a series of years at Rothamsted, scarcely a third of the nitrogen of the manure was found in the crop under the most favorable conditions, while, in those cases in which no mineral manures were applied, the deficit was much greater. The most obvious conclusion was, that there must be a great loss of nitrogen in the drainage; and experiments were instituted to test this idea. Their earlier experiments were with three lysimeters. Excavations were made under and around an area of a thousandth of an acre. The mass of soil thus isolated was supported by perforated iron plates, and surrounded by masonry, thus leaving the soil with its natural structure. The quantity of water percolating through this soil has been determined since 1870; and since May, 1877, its content of nitrates has been also determined. The soil was uncultivated and free from vegetation. Numerous interesting facts are disclosed by these determinations, but that which now interests us chiefly is the quantity of nitrogen found in the drain-water. This amounted, in the average of four years, to 46, 36, and 44 pounds per acre, at depths respectively of 20, 40, and 60 inches.

Subsequently the same experimenters have determined the nitrates in the drainage-waters from their experimental wheat-field, each plot of which is drained by a single lateral at a depth of 24 to 30 inches. Having no means of measuring the drainage, the authors take, as the basis of their calculation of the loss of nitrogen, the amount of drainage-water yielded by the 60-inch deep lysimeter at the same time. On this assumption, the annual loss of nitrogen varied from 15 and 16 pounds per acre, on unmanured plots, to as high as 74 pounds per acre.

It is greatly to be regretted that the authors were not able to measure the drain-water in these experiments; for the method which was adopted to supply the deficiency leaves much to be desired. The soil in the lysimeter was uncultivated and bare of vegetation: that of the wheat-field was cultivated, and bore crops of wheat varying considerably in amount. Both these circumstances affect the amount of drainage-water. Cultivation, especially of a clay soil such as that at Rothamsted, may affect very markedly the ease with which water passes downward through it, the amount of water which it can retain in its interstices, and the rapidity of evaporation from its surface. The growth of vegetation exerts a still greater effect on the movements of water in the soil. It has been shown by numerous observers, that much more water evaporates from a soil covered with vegetation than from a bare soil, and that consequently much less of the rainfall percolates through the soil. The diminution of the drainage-water in this way has also been directly proved by Wollny. Furthermore, the various plots in these experiments carried unequal quantities of vegetation, so that the amount of evaporation due to this source must have been unequal also. It appears, then, in the highest degree improbable, that the quantity of drainage-water actually was the same for each plot as was assumed, and unlikely that it was as great as was assumed. When we add to these considerations the fact, that it is uncertain whether the soil of the lysimeter represented an average of the soil of the field, and, further, that all errors of the lysimeter are multiplied a thousandfold when the results are expressed per acre, we are forced to the conclusion that the figures given for the total amount of drain-water, and consequently those also for the total loss of nitrogen in this way, can be, at best, only approximations, and are most likely too large.

[1] *Journ. roy. agric. soc.*, xvii. and xviii.

[2] *Annales agronomique*, viii. 321.

Even if we allow them their full value, however, they do not in all cases cover the entire loss of nitrogen. On the basis of the results just described, the authors have calculated the average annual amount of nitrogen in the manure, crop, and drainage of fourteen experimental wheat-plots for a period of thirty years. In seven cases the nitrogen found in crop and drainage is from 14 to 40 pounds per acre less than the amount applied as manure. Analyses of the soil of one plot in 1865, and again in 1881, showed that about a third of this amount was still present in the soil, the latter having gained nitrogen. The authors believe the remainder either to have escaped the drain-tiles, and been carried into the lower strata of the soil, or to have been set free in the gaseous state in the soil.

Dehérain's experiments were intended to determine the total loss of nitrogen by the soil. Three series, of four plots each, were laid out, each plot having an area of one are (equal to about four square rods). The first series bore fodder-maize; the second, potatoes; the third, beets, fodder-maize, and esparcette successively. During the first three years, one plot in each series was unmanured; one received, per hectare, 80,000 kilograms of stable-manure; one, 1,200 kilograms of nitrate of soda; and one, 1,200 kilograms of sulphate of ammonia. During the following four years none of the plots received any manure. At the beginning of the experiments, and at the end of three and seven years respectively, the percentage of nitrogen in the soil was determined. With the aid of these determinations, a balance was struck for each plot between the nitrogen originally present and that added in the manure, on the one hand, and that removed in the crops and remaining in the soil at the close of the experiments, on the other hand. In every case except that of the esparcette, a very great loss of nitrogen was found to have occurred. The following table contains the annual loss of nitrogen from a portion of the plots, reduced to pounds per acre to compare with Lawes, Gilbert, and Warington's results: —

Maize plots.

Manuring.	First period.	Second period.
Stable-manure	− 257	− 118
Nitrate of soda	− 358	− 183
Sulphate of ammonia	− 320	− 132
Nothing	− 338	− 93

Esparcette plots.

Manuring.	First period (roots and maize).	Second period (esparcette).
Stable-manure	− 808	+ 327
Nitrate of soda	− 663	+ 134
Sulphate of ammonia	− 732	+ 135
Nothing	− 567	+ 149

Compared with the losses observed in Rothamsted, some of these figures are enormous, being over nine times as great as the highest obtained there. When we consider that the soil was calculated to contain, to a depth of 14 inches, only about 7,000 pounds of nitrogen per acre, they seem to show that but a comparatively short time would be required to reduce the supply of nitrogen to the point at which culture ceases to be profitable.

In order to be able to judge of the force of these results, it is desirable, in the first place, to consider somewhat more in detail the method by which they were obtained. At the beginning of the experiments the soil was found to contain .204% of nitrogen; and this was made the basis of the calculation for all the plots. It is highly improbable that this assumption of uniformity among all the plots, as regards nitrogen, is correct; and, when we consider that a difference of .001% corresponds to a difference of about 34 pounds of nitrogen per acre, we are led to question, not only the accuracy of Dehérain's results, but the possibility of discovering small losses of nitrogen by means of soil-analysis. The absolute quantity of nitrogen was calculated on the further assumption that one hectare of soil to a depth of 35 centimetres weighed 3,850,000 kilograms, which, again, involves a possibility of error. Finally, the determination of the quantity of nitrogen removed in the weighed crops rests on assumptions as to the percentage of nitrogen they contained, while it is a well-established fact that considerable variations in this respect occur. Especially does heavy manuring with nitrogenous fertilizers, such as some of these plots received, tend to increase the percentage of nitrogen in the crop.

To recapitulate: Dehérain's conclusions involve three improbable assumptions; viz., pertect uniformity of soil as regards nitrogen, equal weight of soil over equal areas, and a uniform and average percentage of nitrogen in the crops.

On the other hand, all but a few of the plots show a loss of nitrogen; and while, for the reasons just stated, the accuracy of the reults is very questionable, it would appear that we must admit some loss of nitrogen to be probable in most of the experiments.

Aside from these considerations, however, there are others which should be borne in mind. During the first three years the manured plots were very heavily manured. Sulphate of ammonia and nitrate of soda were applied at the rate of 1,070 pounds per acre, and stable-manure at the rate of over 35½ tons per acre, — quantities much greater than would be used under any ordinary conditions. Moreover, from the fact that the unmanured plots yielded nearly as large crops at the close of the experiments as at their beginning, we may conclude that the soil was naturally of good quality.

Dehérain's calculations show that but a very small proportion of the nitrogen of the manures was utilized by the crops; and, though the exactitude of his figures may be questioned, the general result is what we should expect. A large excess of available nitrogen was evidently present in the soil. The latter was occupied by crops for only four or five months of the year, at most (except the esparcette plots); and, during the remaining two-thirds of the year, leaching, and other

natural agencies which tend to remove nitrogen from the soil, had undisputed possession of the field. When the manuring was discontinued, the losses of nitrogen, according to Dehérain's results, sank very materially, though still remaining considerable.

From the combined results of both these investigations, it would appear that we may fairly conclude, that, under ordinary conditions of tillage, there is considerable loss of nitrogen from the soil. Lawes, Gilbert, and Warington's experiments show that much nitrogen may escape in the drainage; and, according to their calculations, more nitrogen was removed from six out of thirteen of their experimental plots in crop and drainage, during thirty years, than was supplied in the manure. From Dehérain's experiments we learn that a soil under constant tillage may grow poorer in nitrogen in spite of heavy manuring. In fact, of all the elements of the soil which are required for plant-growth, nitrogen is one of the most mobile. The soil, it is true, has the power of fixing ammonia in insoluble combinations; but both ammonia and organic nitrogen are constantly being converted into nitric acid in every fertile soil, and this compound the soil has no power to retain. Under natural conditions, when the soil is thickly covered with vegetation, this nitric acid is assimilated by the roots as rapidly as it is formed, while the compact state of the soil hinders access of oxygen to the deeper layers, and thus moderates nitrification. This action of plant-roots in arresting nitrates on their way to the lower strata of the soil is shown very plainly in Lawes, Gilbert, and Warington's experiments already cited. While the land carried a crop of wheat, the drain-water contained little or no nitrates, except when an excess of nitrogen had been given in the manure; but as soon as the crop was removed, nitrates made their appearance in the drain-water.

But an untilled soil is not only protected against losses of nitrogen: it is also in condition to retain the nitrogen brought to it in rain, snow, etc. This comes partly in the form of ammonia, which is fixed by the soil, and partly in the form of nitric acid, which is fixed by the vegetation. In this way a soil carrying permanent vegetation may be continually gaining nitrogen. This is indicated by Dehérain's results on the esparcette plots, and, aside from them, is sufficiently evident from the facts, that at some period of the world's history all its nitrogen must have existed in the free state, and that, so far as we know, the combined nitrogen of atmospheric precipitates is the sole natural source of nitrogen to the soil.

Tillage alters this state of things very materially. By breaking up and mellowing the soil, it facilitates the access of oxygen, and increases the rapidity of nitrification. At the same time, the natural vegetation is replaced by one occupying in many cases but a part of the ground, and occupying it for but a portion of the year. Add to this that by diminishing the amount of vegetation we diminish the evaporation of water, and thus leave the soil moister, and at the same time expose it more fully to the sun's rays, thus rendering it warmer, both of which conditions favor nitrification, and we see that cultivation both increases the flux of nitrogen in the soil, and decreases the means of utilizing it.

The clear recognition of this state of things brings with it the suggestion of at least a partial remedy, which is to keep the soil occupied as fully and as long as possible with growing vegetation. The roots of the living plant lend to the soil an absorptive power for nitrogen compounds, similar to that which it has of itself for other elements of plant-food, and enable it to store up these compounds against future needs. To prevent a loss of nitrogen, we must make use of this power as fully as possible, both in the system of cultivation adopted, and in other ways. After taking off a crop in the early fall, instead of leaving the land bare, let it be sown with some quick-growing crop, e.g., rye, which shall serve solely to store up the nitrogen which would otherwise be lost. In the spring this crop is ploughed under, and furnishes nourishment for the succeeding crop. Such a plan has been adopted here and there with advantage. Its general use would turn largely, of course, on the question of expense. On a virgin soil containing already large reserves of nitrogen, no appreciable benefit might result from it, though even there the *preservation* of the present fertility is worth striving for. But between this condition and the state of relative exhaustion to which the soil of our older states has been reduced, there must be a point where saving nitrogen in this way would be of immediate as well as prospective benefit. The exact methods of applying the principle involved to particular cases it is not the province of this article to discuss. The principle itself, however, is very simple. Keep growing roots present in the soil as long and as extensively as possible to seize upon the nitrogen (and other elements as well) which will otherwise be washed out of the soil, and to store it up in insoluble forms, ready for the needs of future crops.

H. P. ARMSBY.

THE LIFE OF HAMILTON.

Life of Sir William Rowan Hamilton, Knt., LL.D., D.C.L., M.R.I.A., Andrews professor of astronomy in the University of Dublin, and royal astronomer of Ireland, etc.: including selections from his poems, correspondence, and miscellaneous writings. By ROBERT PERCEVAL GRAVES, M.A., sub-dean of the Chapel royal, Dublin. Vol. i. London, *Longmans, Green, & Co.*, 1882. 20+698 p. 8°.

THIS volume, which forms one of the latest issues of the Dublin university press series, has been prepared partly through the assistance furnished by the Board of Trinity college, and published by the provost and senior fellows. Mr. Graves had at first, however, undertaken the biography of Hamilton on his own responsibility, and unassisted in the labor which it involved; and we ought not to pass unremarked his especial fitness for the performance of this arduous task. In the first place, he was unconnected with Hamilton by

any tie of kindred. Both had experienced unbroken friendship from early youth. Hamilton, in his will, had nominated Mr. Graves as his literary executor; and the sons of Hamilton asked him to undertake the task, seconded by the approval of several of the most influential friends of the great mathematician. And, while Mr. Graves has to confess himself to be no mathematician, he combined — what was of greater import — the requisite amount of personal knowledge with the appropriate scientific attainments and freedom from incompatible engagements. In his preface, the author very gracefully says, by way of allusion to his self-distrust in assuming the control of Hamilton's voluminous papers and correspondence, "I gave a reluctant consent, wishing that the memory of my friend had been more fortunate, but at the same time conscious that by me would be devoted to it the warmth of honest affection and admiration, and the desire to be just and truthful."

In recording the successive mathematical discoveries of Hamilton, Mr. Graves does not attempt accurately to appreciate their importance, or to give them their exact place in connection with precedent or subsequent discovery. He has taken pains to secure that the mathematical statements in his work are correct, giving them generally in the *ipsissima verba* of Hamilton himself, and, where in doubt, consulting friends of competent authority. This course begets a desirable confidence in the accuracy of the entire work, — which is, however, taken as a whole, almost purely a literary biography. It is not so much to the credit of Mr. Graves as may at first seem probable, that he leaves the letters of Hamilton almost unaided to tell the story of his life. The contributions from the author's pen are very largely of the nature of disconnected comment, usually upon a subjoined letter: in fact, there is nothing approaching a continuous analysis of the life or work or character of Hamilton, such as we may hope to see in a subsequent volume, and which Mr. Graves, from his evidently keen insight, and thorough acquaintance with the subject of his biography, is of all persons most fully qualified to write. Nor could the book have been otherwise than improved, had he drawn very largely from his own association and personal recollection of Hamilton in the interest of those who never knew him.

The name of William Hamilton has conferred a threefold distinction upon the kingdoms of Great Britain. An early article on the subject of this biography reminds its readers that each isle has its Sir William Hamilton. The Englishman was noted for his patronage of art, the Scotchman was among the first in philosophy, and the Irishman was among the first in mathematics. And the promise of greatness the young Irishman gave at that early day failed in no sense of entire fulfilment in the development of mature years. Of the three Hamiltons, William Rowan was easily the chief. We recall in this connection what some of his most distinguished contemporaries have said of him. The celebrated Dr. Brinkley, astronomer royal of Ireland (later Bishop of Cloyne, and whose successor in the former office the youthful Hamilton was so soon to be), said of him at the age of eighteen, "This young man, I do not say *will be*, but *is*, the first mathematician of his age." The brilliant and learned Professor Sedgwick, referring publicly to Hamilton in 1833, spoke of him as "a man who possessed within himself powers and talents perhaps never before combined within one philosophical character." Hamilton was born in Dublin, Aug. 4, 1805, and died in the same place, from an attack of gout, Sept. 2, 1865, being then royal astronomer of Ireland. His early life is the story of alarming precocity, not of invention, but of acquisition. Nothing could have seemed more certain to those who knew the boy of half a score than that middle life would easily insure him rank as the chief of linguists. At five he was able to read and translate Latin, Greek, and Hebrew; at eight, he knew Italian and French; and before the age of ten his father wrote of him, "His thirst for the oriental languages is unabated. He is now master of most, indeed of all except the minor and comparatively provincial ones. The Hebrew, Persian, and Arabic are about to be confirmed by the superior and intimate acquaintance with the Sanskrit, in which he is already a proficient. The Chaldee and Syriac he is grounded in, and the Hindoostanee, Malay, Mahratta, Bengali, and others. He is about to commence the Chinese." One of Hamilton's earliest productive efforts was the preparation of a little manuscript book of thirty pages, formally entitled 'A Syriac grammar, in Syriac letters and characters,' etc. (p. 51). He was not as yet twelve years of age; and before another year had passed, his works included (these are the titles given by the boy himself) 'A grammar of the Sanskrit language,' 'An Arabic praxis,' 'An analysis of a passage in Syriac,' and 'A compendious treatise of algebra,' which latter proceeds as far as quadratic equations. Up to this point, Hamilton seems to have had no marked disposition toward scien-

tific studies. He had been fascinated by telescopic views of the planets, and had visited the Royal observatory at Dunsink. Unquestionably one of the most important events in his early career was the meeting of Zerah Colburn. The two had engaged in trials of arithmetical skill when the former was only twelve; but two years later they re-met, Hamilton being "not so much the antagonist as the critic and the investigator of the methods of the gifted computist." That it would be difficult to over-estimate the significance of this occurrence is evident from a letter by Hamilton to his cousin Arthur, in 1822, wherein he says (p. 111), —

"I was amused this morning, looking back on the eagerness with which I began different branches of the mathematics, and how I always thought my present pursuit the *most* interesting. I believe it was seeing Zerah Colburn that first gave me an interest in those things. For a long time afterwards I liked to perform long operations in arithmetic in my mind; extracting the square and cube root, and everything that related to the properties of numbers. It is now a good while since I began Euclid. Do you remember when I used to go to breakfast with you, and we read two or three propositions together every morning? I was then so fond of it, that, when my uncle wished me to learn algebra, he said he was afraid I would not like its uphill work, after the smooth and easy path of geometry. However, I became equally fond of algebra, though I never mastered some parts of the science. Indeed, the resources of algebra have probably not been yet exhausted."

The practical bent of his young mind in scientific matters is interestingly shown by his invention of a telegraphic signal-code, which, for a youth of fifteen, is not a little remarkable. The letters of the alphabet were first arranged in the following scheme (p. 88): —

	1	2	3	4	5
1	A	B	C	D	F
2	G	E	H	J	K
3	L	M	I	N	P
4	Q	R	S	O	T
5	V	X	Y	Z	U

Twice U = W

Then five readily distinguishable positions of the arms were chosen. Each letter, thus, would be indicated, after the manner of a double-entry table, by its position at the intersection of a horizontal and a vertical column; and the numbers of these intersecting columns, transmitted from one station to the other by the pre-arranged signals, would thus spell out any desired message. It will be observed that the duplication of any given position of the arms always indicates a vowel. This device for communicating at a distance was for a time practically employed by Hamilton and a playmate of his, each being provided with a telescope, so that he could readily discern the successive positions of the arms of the other. His devotion to astronomy had by this time taken firm hold; and Hamilton realized this so fully himself, that he forcibly made in his studies a 'sudden transition to natural philosophy,' excusing himself therefor to his friends by explaining that the "intention was to prevent my giving up too much time to astronomy by diverting my thoughts to another channel: '*atqui emovit veterem mire morbus novus*,' for I am now as deeply engaged in the study of pendulums." In a short paper, at the age of sixteen, he brings science to the assistance of the classics, finding astronomical calculation to help in the decision of a moot-point in the chronology of the Aeneid.

It is most interesting to follow the growth of Hamilton's young mind as his fondness for the mathematics increased, and his devotion to the classics waned. His pre-collegiate letters abound in passages evincing the radical change which was going on, and the solid permanency with which his new favorites had taken possession. A passage from a letter to his sister Eliza, shortly after his entering Trinity college, is cited here as a vigorous illustration of this: —

"One thing only have I to regret in the direction of my studies, that they should be diverted — or rather, rudely forced — by the college course from their natural bent and favorite channel. That bent, you know, is science — science in its most exalted heights, in its most secret recesses. It has so captivated me — so seized on, I may say, my affections — that my attention to classical studies is an effort, and an irksome one."

Immediately on abandoning his absorbing interest in the classics, his work of original research in mathematical optics began. Mr. Graves quotes the title of an "Essay on equations representing systems of right lines in a given plane," etc., — a paper of twenty-one folio pages, to which Hamilton himself had appended the following note: "(This curious old paper, found by me to-day in settling my study, must have been written at least as early as 1822. It contains the germ of my investigations respecting Systems of rays, begun in 1823. W. R. H., February 27, 1834.)"

Hamilton's college career was a most brilliant one. During no small portion of his leisure, he was at work developing the germs of the above-named investigation, which, in the spring of 1827, was presented to the Royal Irish academy, having been expanded into 'A theory of systems of rays.' The first part was published the following year in the fifteenth volume of the academy's transactions. His collegiate course had not been completed, when, less than twenty-two years of age, he was unanimously elected Andrews professor of astronomy in the University of Dublin, and royal astronomer of Ireland, — an extraordinary preference for an undergraduate, who had for competitors men of high standing and eminence in two universities. His appointment under these circumstances involved another exceptional event: by the donor's direction, the professor of astronomy is one of the examiners for Bishop Law's prize, which is yearly bestowed upon the best answerer in the higher mathematics among candidates of junior bachelor standing. The new occupant of the chair of astronomy was, within a few days of his appointment, called upon to take his part in the examination; an undergraduate thus officially examining graduates in the highest branches of mathematics.

In the following autumn, Hamilton met the poet Wordsworth. Their correspondence of years, in terms of close intimacy, is very fully given by Mr. Graves, and forms the richest extra-scientific contribution to this biography. We may appropriately allude, in this connection, to Hamilton's poems, with which a very considerable fraction of this large volume is filled. Wordsworth criticised these effusions very freely, and not a few of them are certainly unworthy of Hamilton's better moments. The subjects chosen for versification, however, show an instinctive correctness in the choice of objects and impressions, which, treated by a poet, would be poetry, but, as dealt with by Hamilton, are in general merely healthy ideas plainly and unpoetically expressed in rhyme or verse. Another friendship of Hamilton's we should not omit to mention, — that of the philosopher Coleridge, whom he met in London shortly before the former's death. Their spirited metaphysical correspondence is a very agreeable feature of the present work.

To the wisdom of the same board of electors which, without doubt, saved Hamilton to science from the church (for he had at one time serious intention of entering that body, and was more than once offered ordination), are due the thanks of mathematicians perpetually for their prompt recognition of the true sphere of his intellectual activity. The duties of his university chair, as director of the observatory, were in large part uncongenial to him, and his brief career as a practical astronomer was not a successful one. His tastes being almost entirely in the direction of mathematical research, it was ultimately fortunate, that, from the commencement of his practice as an observer, his vigor of constitution was seriously impaired. Near the close of 1830 he writes to Sir John Herschel, "I cannot say much for my diligence in observing, but perhaps may have a better account to give of this department after some time; though among other temptations to indolence, I have that of always suffering in health when I attempt night work in the transit-room." He had constant cold in the head and chest, and was much of his time confined to the house. The proposal was soon made that he should change the professorship of astronomy for that of mathematics; and consulting with his friend, the late Dr. Robinson of Armagh, the latter replied. —

"Your course appears to me so clear that there can be no hesitation. As a mathematician you will probably have no equal in Britain, as an astronomer some superiors; for you certainly have not the *practical* enthusiasm which is essential to make one sustain the uniform progress of observing. I was well aware that you are not very fond of observing; but you know you have that in common with Encke (who *hates* it), Airy, and Pond (now never observing)."

In November, 1831, the university board passed a resolution which more than doubled Hamilton's salary, and completely defined his future relations to the university; giving him entire liberty to pursue, as a first object, his mathematical researches, and thus assuming the responsibility of his continuing as a mathematician rather than an astronomer.

Hamilton's friends were not slow to do themselves the honor of proposing his membership of scientific bodies. Through Sir John Herschel he became a member of the Royal astronomical society at the age of twenty-two; three years later he was introduced to the British association for the advancement of science; Lubbock was ready to insure his election to the Royal society (of which, however, he never became a fellow); and in a letter, in 1832, to his intimate companion, Aubrey de Vere, he says, (p. 610), "A hand has lately been stretched forth to me across the Atlantic; a diploma having been sent, with great pomp of broad-seal, and so forth, to tell me that I have been

elected fellow of the American academy of arts and sciences —

"Ueber länder und meer reichen sich beide die hand."

A picture of curious interest may be drawn from Mr. Graves's occasional touches, portraying Hamilton as a speaker and lecturer. He "had two voices — one deep, rich, sonorous, rhythmical, and solemn, which flowed forth when he delivered a prelection or a speech, or recited poetry; the other soaring acutely into high regions, when he burst into an explanation, or gave vent to some ebullition of good spirits or cheerful comment." At the meeting of the British association in 1832, at Oxford, his speech returning thanks on behalf of the Royal Irish academy contained "a graceful expression of the feelings stirred in him by his peculiar position as the solitary and youthful representative of Ireland on the occasion." Babbage told him, in congratulation, that "an astronomer had no business to be able to speak so well." We have space for only a word from Mr. Graves's charming sketch of Hamilton as a lecturer (pp. 497–498): —

"When he spoke . . . it was plain to see that he was absorbed by a reverential consideration of the grandeur of astronomy. . . . As he poured out in his sonorous tones his thoughts thus blending poetry and science, he appeared . . . absorbed in awed and delighted contemplation of the truths he had the solemn privilege of enouncing; there was no apparent consciousness of his own personality, he was a worshipper revealing the perfections of the object of his worship; and towards the youthful audience who surrounded him he took the attitude not so much of a superior authority and a teacher as of a worshipper desirous that other intelligent spirits should take fire from the flame of his devotion. . . . In these introductory lectures he was wont to indulge himself in refined and eloquent disquisition, in poetic language, quotation and allusion, in tracing the history of the development of the science, and in marking out the achievements of its great promoters. . . . The subsequent lectures of the course were altogether different in style, being rigorously mathematical and demonstrative. . . . They were delivered with an eager simplicity, in a voice often breaking into a high key, strangely contrasting with the deep roll of his oratorical effusions."

One of Hamilton's grandest achievements was the theoretical discovery of conical refraction; and in the popular history of physics he is chiefly known by this. Its prompt confirmation by Dr. Lloyd, in the laboratory of the Dublin university, tended strongly to heighten the dignity of the discovery. It was characterized in terms of most extravagant applause by the greatest physicists of that day. But Hamilton himself, with the unaffected simplicity of true genius, describes it to Coleridge as a 'subordinate and secondary result.' The discovery had no parallel in the history of exact science; and, as Mr. Graves appropriately remarks, it is only "to be classed with that prediction of the existence of the planet Neptune which has immortalized the names of Adams and Le Verrier."

Nothing, perhaps, will better exemplify Hamilton's rare elevation of character than the following brief words of his biographer: —

"It is to Hamilton's honour that the impression he made upon young men, his coevals and his juniors, was such as to create in them the warmest affection, admiration, and respect. This arose from his unaffected humility and his cheerful communicativeness, combined with his power to solve most difficulties admitting of solution, his frankness in confessing ignorance, his reverential and profound treatment of all great questions."

In so far as it is possible to know the distinguished Irishman from his letters, — and they are presented in the fullest profusion, — the most commanding feature of his character is the absolute absence of every thing akin to meagreness of build: in other words, a thorough and genuine nobility. Repeated illustrations of this might be cited from his correspondence; and it is the most conspicuous element of the admirable frontispiece which has been autotyped from a photograph by Chancellor, Dublin, of a miniature bust executed by Terence Farrell in 1833. We should like to express the hope, that, before the conclusion of his task, Mr. Graves will present a print from the other bust of Hamilton, executed, at the request of Lord Dunraven, by the Dublin sculptor, Kirk; in preparation for which a cast was taken from the head, and which thus, as faithfully representing his cranial development, can hardly fail to possess a permanent value.

It is most irksome to be forced from the contemplation of this great genius; for, with this initial volume of his biography, we have to leave him at the age of twenty-seven, and almost in entire anticipation of his characteristic scientific life. His unique researches in the highest fields of mathematical investigation, his great contributions to the science of dynamics, were yet unmade; and the calculus of quaternions, if at all thought of, had no more taken shape than the vague indefiniteness of a dream. If Mr. Graves has disappointed any of his readers in the execution of his task, they must be few, and among those who were so favored as to have enjoyed the intimate acquaintance of the great mathematician. The successive instalments of this exceedingly valuable biography cannot fail to be watched for with eagerness, and welcomed with enthusiasm, by all whose interests embrace the history and development of the exact sciences.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

San Diego natural history society.

Nov. 2. — The following officers were elected: president, Dr. G. W. Barnes; vice-president, Joseph Winchester; recording secretary, E. W. Hendrick; corresponding secretary, Rosa Smith; treasurer, C. J. Fox; librarian, Mrs. Z. R. Cronyn; curator, Dr. D. Cave; directors, D. Cleveland, G. W. Barnes, C. J. Fox, E. W. Morse, J. G. Capron.

The following papers were read. Historical notice of Pinus Torreyana; by C. C. Parry. — In the spring of 1850, when connected with the Mexican boundary survey, my attention was first called to a peculiar species of pine growing on the Pacific coast, at the mouth of the Soledad valley, San Diego county, by a casual inquiry from Dr. J. L. LeConte, then staying in San Diego, asking what pine it was, growing near the ocean beach at that locality. Not having any specimens to show, he simply mentioned at the time its dense cones, and its long, stout leaves (five in a sheath). Not long after, an opportunity offered to the writer for a personal investigation, having been ordered by Major W. H. Emory to make a geological examination of the reported coal-deposits on the ocean bluff above Soledad. From the notes and collections there made, a description was drawn up, dedicating this well-marked new species to an honored friend and instructor both of Dr. LeConte and the writer; viz., Pinus Torreyana, Parry. Of the few specimens then collected, a single cone and bunch was sent to Dr. Torrey to be figured for the Mexican boundary report. While there, it fell under the notice of some inquisitive botanist, who extracted some of the loose seeds, which were planted, but by some inadvertence were mixed with another three-leaved species. When growing, the two different kinds became confounded, and it was inferred that the present discoverer was mistaken in regarding this species as five-leaved. Prof. Parlatore, the elaborator of Coniferae in de Candolle's 'Prodromus,' added to this confusion by ignoring the name first proposed, and substituting that of Pinus lophosperma. Subsequently, frequent collectors have visited this locality, bearing away to the remotest portions of the world seed of this pine, which, as far as is known, is exclusively confined to a coast-line of not more than four miles, lying between San Dieguito and about a mile below Soledad, and extending scarcely a mile inland. The bulk of the tree-growth is here mainly confined to a series of high broken cliffs and deeply indented ravines on the bold headlands overlooking the sea south of Soledad valley, and within the corporate limits of the town of San Diego. Here, within a radius of not more than half a mile, this singular species may be seen to the best advantage, clinging to the face of crumbling yellowish sandstone, or shooting up in more graceful forms its scant foliage in the shelter of the deep ravines, bathed with frequent sea-fog. One of the finest specimens seen reaches a height of nearly fifty feet, and shows a trunk eighteen inches in diameter at base.

The chair was instructed to appoint a committee of three (to be named hereafter), to report and act upon such measures as may be deemed best for the preservation of the remnant of the Pinus Torreyana at Soledad, treated of in the communication of Dr. Parry.

Additions to our flora and fauna; by C. R. Orcutt. — The writer stated, that, since the last annual meeting, over a dozen discoveries have been made in species of plants indigenous to this section, while many more have been discovered unknown hitherto in California.

Notes upon spiders; by Rosa Smith. — Zilla rosa, which I discovered at San Diego less than a year ago, is the commonest orb-weaver in San Francisco and vicinity, spinning its delicate snare on trees, bushes, and fences about the city, at Golden Gate Park, and at the Cliff House. Even inside the walls of the California academy of sciences, I have seen its lovely web, accompanied by silken cocoons of its eggs. This spider is easily known by the free radius in the snare, — 'a good wedge cut out of the pie,' Dr. McCook expresses it, — which is peculiar to the genus Zilla. At Aptos, near Santa Cruz, I secured an Epeira, and cocoon of eggs and young spiders, which have revealed some curious facts in regard to insect parasites. Of these Dr. McCook writes, "One interesting thing about the Epeira atrata cocoon is, that it is strangely infested by parasitic and other enemies, no less than four. There were first a number of small reddish ants alive, probably a species of Solenopsis, who no doubt were feeding upon the eggs and *débris*; second, several larvae of Dermestidae, probably Attagenus pellio. These were creeping into the silky interior at will, though some of them were ensconced within the empty cells of some ichneumon. Next I found alive a very small ichneumon fly. I have never yet seen quite such a 'happy family' within the bounds of a spider's egg-nest. The spiderlings seemed to be contented, and indifferent to the presence of these intruders." A few days later, Dr. McCook sent more information, as follows: "Since writing you, I find from Mr. Cresson that the larger ichneumon is a Pezomachus; and the small one, as I conjectured, a chalcid of some sort, which is parasitic upon Pezomachus. As Pezomachus is parasitic upon spiders' eggs, their presence within the cocoon is thus accounted for. By the way, there is a yet minuter chalcid that is parasitic upon the chalcid, that is parasitic upon the Pezomachus, that is parasitic upon the eggs of Epeira atrata and other spiders."

Natural science association of Staten Island.

Dec. 8. — Mr. Hollick gave an account of the recent discoveries of fossil leaves at Tottenville. There are three distinct kinds of rock containing these fossils, — a hard red or gray ferruginous sandstone, a soft gray sandstone, and a peculiar conglomerate composed almost wholly of vegetable remains cemented together with what is apparently limonite or sesquioxide of iron. In the soft gray

sandstone the remains are not yet destroyed, but are in the form of carbon or lignite. In the other rocks the vegetable tissue has almost entirely disappeared, and only the impressions remain. The rocks are found in blocks or fragments, none of them greater than a foot square, scattered along the beach, mostly at the base of the bluff, which is composed of drift. From our present knowledge, it is not possible to decide whether they were torn up from an outcrop below high-water mark and cast upon the beach, or washed out from the base of the bluff: they no doubt belong to the cretaceous, although our present proofs are not yet sufficient to state this to a certainty.

A note was read from Dr. Britton of Columbia college, in which he stated that the occurrence of similar fossiliferous sandstones on the beach near Glen Cove, Long Island, and vicinity, had been known for some time. There they are found in precisely the same position as at Tottenville, and are associated with extensive beds of fire-clay, kaoline, etc. The Tottenville station is not immediately on these clays, but they are found near by in several directions, notably at Kreischerville. That the two localities mark outcrops of the same geological formation, and probably approximately of the same strata, is almost certain. The physical structure of the Glen Cove series is exactly parallel to that of certain of the clay beds of Middlesex county, N.J., which are well known to belong to the cretaceous epoch. In the absence of sufficient fossil evidence, we cannot state with absolute certainty that the two deposits are equivalent; but there is little doubt that this will ultimately be proven, and that the New Jersey and Staten Island clays, kaolines, lignites, etc., find another and their most northern outcrop on the north shore of Long Island, at or near Glen Cove.

The exact parallelism between our Staten Island specimens and those from Glen Cove, continued Mr. Hollick, can be seen at a glance: in fact, they would be indistinguishable but for the labels, with the exception of the leafy conglomerate before described, which does not seem to be represented elsewhere; it is possibly peculiar to Staten Island.

In determining the genera and species of fossil plants, we have to depend mostly upon the veining of the leaves, which is not by any means so satisfactory as we could wish. Genera can be determined with comparative accuracy. Thus we have no doubt that one of our Tottenville fossils is a willow, though what particular species, it is impossible to say; another is undoubtedly an evergreen, allied to our juniper or arborvitae. The larger specimens are probably willows, viburnums, and sour gums. There are also a few fragments with parallel veins, — no doubt, belonging to the grasses, — a small fruit or nut, and a piece of what appears to be an equisetum or horse-tail rush. These, with other indistinguishable fragments, complete our list.

Cambridge entomological club.

Dec. 14. — Mrs. A. K. Dimmock showed a collection representing stages of thirty-eight species of insects which are found upon Betula alba, the white birch, which will be given later in *Psyche.*

Mr. G. Dimmock showed the two halves of a split wing of Attacus cecropia, in which the two layers of the wing had been separated by the following mode. The wing from a specimen that had never been dried is put first into seventy per cent alcohol, then into absolute alcohol, and from the latter, after a few days' immersion, into turpentine. After remaining a day or two in turpentine, the specimen is plunged suddenly into hot water, when the conversion of the turpentine into vapor between the two layers of the wings so far separates these layers that they can be easily parted and mounted in the usual way as miscroscopical preparations on a slide. This is an easy way of demonstrating the sac-like nature of the wings of insects.

Dr. H. A. Hagen showed preparations to illustrate organs of undetermined function, found on the larvae of Gomphidae, Libellulidae, and Aeschnidae, but not as yet found on Agrionidae, which he believes to be traces of segmental organs. The organs in question are little cavities or invaginations of the epidermis between the segments, one on each side of the median ventral line, on one, two, or three abdominal segments, according to the family to which the larva belongs.

Ottawa microscopical society.

Dec. 18. — Mr. Henry M. Ami read a paper on the use of the microscope in determining fossils, with especial reference to the Monticuliporidae. Late microscopic investigations proved that the more minute organisms found in our rocks were both deserving and requiring such careful investigations; for geologists had been led into erroneous ideas regarding the particular horizon, and range in geological time, of certain species of these fossils from the mere cursory examination given them. Later paleontologists, pursuing their researches in a more scientific manner, had recourse to thin sections of these Monticuliporidae, or fossil Polyzoa, by means of which the true external and internal structures of the zoarium or skeleton of the genera and species belonging to this family were satisfactorily ascertained.

The work of foundation and means devised by Dr. Nicholson (at one time a professor in one of our Canadian universities) inaugurated a new era in the study of these interesting forms. The mode of procedure in preparing thin sections of these fossils was then considered and explained. The different kinds — tangential, longitudinal, transverse, and axial sections — were described, and illustrations of them exhibited in charcoal drawings of some of the common species found about Ottawa city, — Prasopora Selwyni Nicholson, Batostoma ottawaense Foord, and Monotrypella trentonensis Nicholson; the various points exhibited in these sections — such as the large and smaller tubes; cystoid, curved, and straight diaphragm or floors; the spiniform tubuli, etc. — were then described, showing how minutely and accurately their structures and affinities can by this means be detected.

There was still a rich and wide field open for investigation in the study of the Monticuliporidae; and care should be taken first to ascertain with the new and more scientific means the true relations and affinities of the species described previous to 1881.

Mr. Whiteaves exhibited a choice series of recent Polyzoa for comparison with the fossils described in the paper.

Ottawa field-naturalists' club.

Dec. 20. — Mr. James Fletcher read a paper entitled 'Notes on the Flora ottawaensis, with special reference to the introduced plants,' which was explanatory of the lists of plants hitherto published by the club, and in which the non-indigenous species are not indicated. Mr. Fletcher first defined the district from which the plants had been collected, and which lies within a circle of twelve miles radius. He then noted certain of the more interesting of rare or introduced species, and presented lists tabulating the latter plants under the headings of 'Aggressive species,' 'Species able to perpetuate themselves indefinitely,' 'Species dying out after short periods,' etc. An animated discussion ensued, confined principally to the conditions affecting introduced plants, and the spreading of certain species.

Philosophical society of Washington; Mathematical section.

Dec. 19. — Mr. M. H. Doolittle gave a paper on the rejection of doubtful observations, in which observing-errors were sharply divided into two classes, — those resulting from blunders in recording, pointing on wrong objects, neglect of essential precautions in instrumental adjustment, etc.; and those resulting from an unusual accumulation of similar elements of error. The latter class, because by their magnitude in one direction they indicate that the remaining observations are in error in the opposite direction, he proposed to call *instructive* errors, and claimed that the larger they were the more instructive, and the greater the necessity of retaining them. In practice, however, the best rule with suspected observations is to reject them when they exceed the limit of error possible to the 'instructive' class, and when they fall within it to assign a weight proportional to the chance that the error belongs to the latter class, and not the former. As the law of distribution of the former class of errors (if any such law exist) is very different from the recognized law of the latter class, these questions cannot be decided by computation with a 'criterion,' but must be left to the judgment.

Prof. A. Hall gave as a general result of the debate of this vexed question by Peirce, Airy, De Morgan, Stone, Glaisher, Chauvenet, Gould, Winlock, and others, that *every one can devise a criterion that suits himself, but it will not please other people.* He strongly opposed using such machinery in the discussion of observations as eliminated the knowledge and judgment of the investigator, and giving to results a fictitious accuracy by any sweeping rejection of discordant data.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Topographical field-work. — Mr. H. M. Wilson, in charge of one of the topographical parties in Prof. A. H. Thompson's Wingate division, surveyed, during the season of 1883, about ten thousand square miles in north-western New Mexico and north-eastern Arizona. The area covered by his work lies between parallels of latitude 36° and 37°, and extends from meridian 109° to 111°. He also worked some smaller detached areas outside of the limits thus indicated. This region has hitherto remained a *terra incognita*, partly on account of its aridity and barren condition, and partly on account of the difficulty of traversing it. So little has been known of it, that within the area surveyed by Mr. Wilson a small mountain range has been indicated as occupying two places on the same map. On the engineer's map of 1879 it is called Calabesa Mountains in the northern place, and Squash Mountains in the southern; and, on the land-office map for 1882, both are indicated without names. Mr. Wilson's work proves that they are one and the same, occupying a position very close to that assigned to the Squash Mountains.

On the 11th of September Mr. Wilson and one of his men made the ascent of Navajo Mountain (called by the Indians Nat-sîs-aú), and they are probably the first white men who have ever stood upon its summit. Navajo Mountain lies on or near the line between Utah and Arizona, and is a dome-shaped mass rising about four thousand feet above the general level of the surrounding country, and sixty-five hundred feet above the beds of the San Juan and Colorado rivers, which are close to its base, the former on the north, and the latter on the west. Its elevation above sea-level is ten thousand four hundred feet. It slopes abruptly, especially on the east, to a plateau of six to seven thousand feet, which extends south-eastward for fifteen or twenty miles to the cañon where Mr. Wilson left his pack-train in camp. This was on a trail that leads to Fort Defiance, *viâ* the north side of the Mesa de la Vaca and the valley of the Rio de Chelly. Another trail leads southward to Mo-eu-kap-i (a Mormon settlement) and to Oraybe and the other Moqui villages. From a point a few miles south of the Navajo Mountain, a third trail leads westward to Lee's Ferry, on the Colorado River. Mr. Wilson thinks there is also a trail leading to the mountain from the north-west. He says all the trails in this section are exceedingly rough and difficult to travel, on account of the numerous cañons, of five hundred to a thousand feet in depth, which are cut into the red sandstones (triassic?) that form the

surface-rock of the country. On the summit of the mountain, which is about a mile in length, a brownish sandstone occurs, which may possibly be Jurassic or even cretaceous; but all the rocks are probably referable to the Jura-trias, with the exception of some dark igneous rocks which occur as dikes on the slopes of the mountain. Within about a thousand feet of the summit is a spring of good water, where there is a good camping-place. The slopes are timbered; scrubby firs and balsams occurring on the top, with scrub-oaks below, and tall pines still lower down. Among the latter are many beautiful parks. The plateau-level surrounding the mountain is well covered with fine tall grass, over which are scattered patches of piñon pines and small areas of bare red sandstone.

In the walls of a short cañon on the east side of the mountain, passed through by Mr. Wilson in his ascent, ruins of cliff or cave dwellings were seen in a cave or hollow in the rocks about five hundred feet above the bottom, and a hundred feet below the top.

Ascent of Mount Shasta.— Mr. Clarence King, in his 'Mountaineering in the Sierra Nevada,' says, "There is no reason why any one of sound wind and limbs should not, after a little mountaineering practice, be able to make the Shasta climb. There is nowhere the shadow of danger, and never a real piece of mountain climbing, — climbing, I mean, with hands and feet, — no scaling of walls, or labor involving other qualities than simple muscular endurance."

Mr. Gilbert Thompson, who, during the past summer and fall, spent about two months in topographic work on the slopes and summit of Mount Shasta, indorses this statement of Mr. King, and would add that there is no reason why a train of pack-mules may not be taken to the top of the peak. Mr. Thompson and one of his packers (Thomas Watson), on Sept. 10, 1883, tied their riding-mules to the iron signal-post which marks the extreme summit of the cone, and are the first who have ever taken riding-animals to the top of Mount Shasta. On Oct. 12, 1883, the pack-train was taken to an altitude of 13,000 feet, and would have been taken to the top had not the early snows prevented. Another season, however, Mr. Thompson expects to camp with his entire train upon the summit of Mount Shasta. From one of his camps, at an elevation of 7,400 feet, it required seven hours to go to the top with the riding-animals, while one member of the party, starting from the same camp on foot (taking, of course, a more direct route), reached the summit after a climb of six hours. It took two hours to get back to this camp, and three-quarters of an hour sufficed for the return to the camp which was located at the elevation of 13,000 feet. Mr. King and his party in September, 1870, made the ascent from the north-west. The first day they left their riding-animals at an elevation of about 10,000 feet, and climbed as far as the crater on the north-western spur, which point they reached about half-past one o'clock in the afternoon. They spent the night here, and on the following day, after a climb of four hours and a half, reached the summit. Mr. Thompson's ascent, mentioned above, was along a spur that extends toward the south-east. Up this spur he says there is a natural trail, only 500 or 600 feet of which will require any work to make it perfectly safe for mules or horses with packs. The route described by Mr. King, and the one *viâ* a south-western spur, are the routes usually followed by those who make the ascent from Strawberry valley, on the west side of the mountain. One member of Mr. Thompson's party climbed the mountain also from the east, which makes, altogether, four different routes by which it has been ascended. Mr. Thompson says there are two other possible ways by which the mountain can be climbed. These are on the north-east side. He reports, also, that there are seven glaciers located on the north and east slopes of Mount Shasta. Those on the north and north-east are connected at their heads. A north-west and south-east line would divide the glacier-bearing side of the mountain from the non-glacier-bearing half. However, some of the fields of snow and ice on the west side have considerable resemblance to glaciers, and may eventually be so determined.

Mr. Thompson suggests that Mount Shasta would be the best point in this part of the west for a permanent high meteorological station like those located on the summits of Mount Washington and Pike's Peak. Among the several reasons for this opinion, he mentions its accessibility, and the presence of hot-springs, which might be utilized in heating such a station, but more especially the fact that it is an isolated peak, rising high above the surrounding low country, and free, therefore, from the disturbing meteorological conditions induced by the presence of contiguous mountain ranges. Mount Shasta, Mr. Thompson says, does not belong to the Sierra Nevada nor to the Cascade Range, but stands alone.

During the season a line of levels was begun at Berryville, where connection was made with the railroad level, and carried some distance up the mountain. Next year this line will probably be carried to the summit of the peak.

NOTES AND NEWS.

THE Society of naturalists of the eastern United States, whose organization and aims were described in *Science* last spring, held a very successful and interesting meeting at Columbia college, New York, on Thursday and Friday of last week. The attendance was very large, and included many distinguished men. The membership has grown very rapidly, and now includes a large majority of the leading professional naturalists of the eastern states. The papers presented were of a high character, and many of them provoked a discussion such as is rarely heard in any scientific body; for seldom are so many men, devoted to one branch of pure science, gathered together. The communications, almost without exception, referred to problems of practical interest, and dealt especially with methods and the organization of scientific work, and also with methods of teaching.

Upon methods were read several papers, — Pro-

fessor James Hall, On a method of preparing rock-sections; Prof. B. G. Wilder, On the preservation of hollow organs, particularly the heart and brain; Prof. S. H. Gage, On the uses of peroxide of hydrogen in preparing skeletons; Dr. George Dimmock, On the uses of carminic acid in microscopical work; Mr. J. H. Emerton, On models of gigantic cephalopods; Dr. E. B. Wilson, On methods of section-cutting. Upon organization we may note Professor Wilder's paper, On the arrangement of a museum of vertebrates, and Professor Cope's, On academies of science in America, etc. Among the educational communications were those of Dr. Wadsworth, Upon methods of teaching in petrography and mineralogy, and Professor Bickmore's, Upon methods of teaching employed at the American museum, etc. The meeting surpassed in interest all expectations, and assures the future standing and prominence of the society, which, although so young, is yet through its membership so strong. The following officers were elected for the ensuing year: president, Professor Alpheus Hyatt; vice-presidents, Profs. H. N. Martin and A. S. Packard, jun.; secretary, Dr. Charles S. Minot; treasurer, Professor William B. Scott; members at large of the executive committee, Profs. H. C. Lewis and Lester F. Ward.

— The Swiss earthquake of 1881 had its centre of intensity in Berne and nearest vicinity, and is one of the best observed as to its extent and details. The geologic formation of the Swiss plateau, where the motions were most intensely felt, consists of a tertiary sandstone of unknown depth, called molasse, while the limestone rocks of the northern Alpine belt and of the Jura ridge were scarcely touched by it. Prof. Dr. A. Forster, the director of the telluric observatory at Berne, has collected a large amount of well-ascertained details on this earthquake, and published it in an interesting quarto memoir of twenty-nine pages, — 'Das erdbeben der schweizerischen hochebene vom 27 Januar 1881 (Berner beben),' Berne, *B. F. Haller*. The scientific results obtained by him may be summed up as follows: the principal shock occurred on Jan. 27, in the afternoon, at 2h. 19 m. 53 sec., and was preceded and followed by light oscillations of the soil. It took place at a coincidence of the perihelion with the perigee, the new moon being two days and a half later. There were no disturbances of terrestrial magnetism noticed for several days before and after; but a long period of frost had just given way to a sudden thaw, and the upper culmination of the moon had occurred five hours before. The whole area of seismic motion, with its longitudinal axis of two hundred and sixty kilometres, experienced the shock at one and the same astronomic time. There was no central shock, for the dislocation following the shock took place simultaneously upon the whole line. In the majority of places, villages, etc., it consisted of a brief, succussory shaking, followed immediately by a few lateral and less energetic oscillations, all of them possessing a direction running approximately from east to west. The mean duration was but three to four seconds, the intensity varying from three to eight degrees of the Swiss-Italian seismic scale. Noises usually connected with the heavier earthquakes were heard by most observers who happened to be outdoors: they preceded the shock or were synchronous with it, and none were heard after the shock. South of Martigny (Valais) and north of Mulhouse (Alsace) no disturbance was noticed; though numerous oscillations had occurred one and two weeks before, in southern Germany, Piedmont, and Lombardy. Compare A. Heim, on 'Swiss earthquakes in 1881,' published in the Annual of the telluric observatory of Berne (1881).

— Messrs. Cassino & Co. and Estes & Lauriat, of Boston, have issued a prospectus of the 'Standard natural history,' — a work in six volumes, imperial octavo, fully illustrated, and under the editorship of Dr. Elliott Coues and Mr. J. S. Kingsley. The staff of writers announced consists of forty-two names, including the larger part of our best-known authors, and all are men of repute. The first volume, on the lower vertebrates, will be by W. K. Brooks, S. F. Clarke, J. W. Fewkes, A. Hyatt, C. S. Minot, A. S. Packard, and others; the second, on the arthropods, by E. A. Birge, J. H. Comstock, A. J. Cook, J. H. Emerton, G. H. Horn, J. S. Kingsley, A. S. Packard, C. V. Riley, P. R. Uhler, etc.; the third, on the lower vertebrates, by E. D. Cope, T. Gill, S. Garman, D. S. Jordan, etc.; the fourth, on birds, by Dr. Elliott Coues alone; the fifth, on mammals, by E. D. Cope, E. Coues, T. Gill, S. Lockwood, G. Macloskie, R. R. Wright, and others; and the sixth, on the races of man, by C. C. Abbott, L. Carr, W. H. Dall, F. W. Putnam, and S. Salisbury. The work will be published in about sixty serial parts, of forty-eight pages each. The numbers already issued leave nothing to be desired in typography, good taste, and excellence in illustration; and we heartily wish so serious a venture every success.

— A new work on the "Theory of deflections and of latitudes and departures, with special applications to curvilinear surveys for alignments of railway-tracks" is in press by Van Nostrand. The author, Isaac W. Smith, is an engineer for some time connected with the construction bureau of the Northern Pacific railroad.

— 'The legends of the Panjab,' in monthly numbers from August, 1883, by Capt. R. C. Temple, Bengal staff corps, records, in a form useful to investigators, the stories and legends preserved in the memories of the wandering bards of the Panjab. The legends are given in original in the Roman character, exactly as they were taken down from the lips of the narrators, with translations. The work is being published at the Education society's press, Bombay, and by Trübner & Co., Ludgate Hill, London.

— 'The Nautical almanac and astronomical ephemeris for the meridian of the Royal observatory at Greenwich' for the year 1887, commonly known as the British nautical almanac, was published in London late in November. According to *Nature*, the sales of this publication for the last five years have exceeded 15,500 annually.

SCIENCE.

FRIDAY, JANUARY 11, 1884.

COMMENT AND CRITICISM.

THE authorities at Washington show hopeful signs of an interest in the administration of the Naval observatory by proposing the appointment of three eminent astronomers as a board of visitors, who shall annually inspect the establishment, advise with the superintendent respecting the scientific portion of his duties, and report to the secretary of the navy. This measure was recommended by the secretary in his annual report, with the hope that many of the objections now urged against the administration might thus be removed. That he should have expected such a result from this simple measure, leads us to doubt whether the grounds of the objections referred to are fully appreciated, and to suspect that the subject is viewed too much from the stand-point of the politician. The astronomers of the country stand in readiness to give any department of the government any advice which they are assured will be followed, at least in spirit; but they have no taste for the cheap compliment of being consulted for the pleasure of the thing. That fondness of being 'consulted,' that appreciation of the privilege of giving advice, and that love of carrying 'weight' in public affairs, which are so strong in the breast of the politician, are nearly unknown among eminent astronomers. The latter have too many more important affairs on hand to permit of their enjoying the pleasures and duties which fall annually to the boards of visitors of the naval and military academies. They are quite ready to give the government the benefit of their advice, provided they have some assurance that the advice will be acted upon, but not otherwise. Their complaint against the observatory is not that they are not sufficiently consulted, but that the organization of the establishment does not fulfil the condition which common sense shows to be necessary to the efficient administration of a scientific institution.

We have already pointed out what we believe to be the chief administrative wants of the observatory. Briefly summarized, they are, a well-considered plan of operations, to be devised by the highest expert talent of the country, within or without the establishment, and to be obligatory upon the superintendent, and such an organization as shall give reasonable assurance that the plan agreed upon shall be carried out in all the details necessary to its success. For a mere board of advice, it is difficult to see the slightest necessity. The observatory has never been without one or more able astronomers, whose advice the superintendent can command whenever he desires, and who have the great advantage of an intimate acquaintance with the instruments and other means at the disposal of the superintendent. If there is any difficulty in getting and using advice from this source, it is because the situation is such that something else is needed.

JAPAN may well be proud of the honors that have just been won by two of her sons in two of the best universities in Germany. A gold medal was offered about a year ago, by the University of Leipzig, for the best original work that should be produced within a year, on the embryology of the fresh-water planarians. The subject is a very difficult one, and on this account has hitherto received very little attention. Mr. Isao Iijima, formerly a student in the University of Tokio, under Professor Morse, and subsequently under Mr. Whitman, was one of the few students selected by the Japanese government in 1882 to be sent to German universities. Mr. Iijima began work at Leipzig, in the laboratory of Professor Leuckart, early in the spring of 1882. At the

suggestion of Professor Leuckart, he turned his attention to the subject announced for the prize. From the report of the rector, Professor His, which was read at the last *Rectorwahl*, it appears that the prize has been awarded to Mr. Iijima. The following remarks, taken from the printed report, will certainly be of interest to all who are watching the course of events in Japan: —

"The work receives the highest commendation of the faculty. With regard to its actual contents, it must be pronounced a highly successful work. It is rich in fine observation and thoughtful discussion, and furnishes the best evidence of the ability, knowledge, and insight of the author. It is a permanent gain for zoölogy, inasmuch as it places in clear light the organization and development of a group of animals, which, notwithstanding the importance of its systematic relations, was hitherto very imperfectly understood. *Aperta scidula repertum est nomen auctoris, Isao Iijima.*"

In Berlin another Japanese student, whose name we have not obtained, has recently been appointed, over the heads of able competitors, to the post of assistant in anatomy.

The report of the secretary of the navy for 1883 contains a repetition of his recommendations of last year, that all national work connected with the ocean, carried on by other departments, should be transferred to the navy department, to be supervised and performed by naval officers. Most important among the transfers suggested is that of the coast-survey, which is now under the treasury. This he would have placed under the naval hydrographic office, because there are now sixty-seven naval officers and two hundred and eighty seamen employed in the coast-survey; and he adds, that in view of the facts that no part of the hydrographic work of the coast-survey has the faintest traceable connection with the general purposes of the treasury, that its effectual performance is of vital importance to the navy, and that an office exists to-day in the navy department where similar work is necessarily carried on, it is inconceivable why so inconvenient, artificial, and indefensible an arrangement should be perpetuated.

The secretary ignores the fact that the work which these officers perform is routine, the plans and methods for which have been devised and developed by civilian experts; and he fails to compare the character and quality of the work which the hydrographic office and the coast-survey have performed, and to show that an improvement in the quantity or quality of work would be consequent on the transfer.

Since, then, the present method of employing our superfluous navy, under the intelligent supervision of civilian experts, works no injustice to the navy, and since it is and has been found essential to employ civilian experts to carry on the work of the hydrographic office, we see no benefit which can result from the transfer, except the aggrandizement of the navy; and we doubt if this be a sufficient reason. Should the efforts of Mr. Chandler to absorb all the national work on the ocean prove successful, the fish-commission, like the coast-survey, must be transferred to the navy department.

The red glow in the skies long after sunset and before sunrise has attracted the attention of every one in all parts of the world during the last few months. As showing the hesitation of physicists to attack the matter, it is singular that nothing on the subject had been sent to us until within three weeks, since which time a number of letters, describing the appearance as seen by single observers, have been received. In this number an article is printed in which the facts at the disposal of the signal-service are made use of, and the often-broached Java earthquake theory, which has so many adherents among the best scientific men, is again put forward. The not inconsiderable upheaval in Alaska may also have played its part. It would be interesting to know if the records of earlier times contain any mention of similar red skies following large volcanic eruptions.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Sense of direction.

I HAVE been much interested in the different methods of preserving the relative situation of places, as given in late numbers of *Science*, and will venture to add my own experience.

I refer all objects to two rectangular co-ordinate axes which agree with the cardinal points. In all places where I feel at home, these lines are consciously present, and all roads running north and south, or east and west, coincide with, or seem to be parallel to, these axes. All places which I have visited, from Massachusetts to Nebraska, are, with few exceptions, connected together in one system.

The principal origin of this system is in the northwest corner of a schoolhouse in Hamilton county, O. There, when a boy, I sat under the direction of a teacher to study geography. With face toward the north, I looked through a window along the meridian. I could at pleasure see east or west, or, if need be, south, through opposite windows. A thorough course in geography fixed in my mind the axes of my system, which have been present with me ever since, a secondary origin going with me everywhere. All places with which I am familiar form parts of this system, and any new place visited is immediately referred to its proper location.

Now for the exceptions. There was another schoolhouse, where I attended sometimes, at which I was turned a quarter round. East was north, south was east, etc. I account for the anomaly in this way: in going to the schoolhouse where my system was fixed, I went east, along a road from which I turned to the left into the south or front door of the schoolhouse; but, in going to the second school mentioned, I went through fields into a road along which I passed toward the south some distance, and then turned toward the left into the west or front door of the schoolhouse. I lost the direction of my axes of reference in crossing the fields; so that the west side of the new schoolhouse seemed to coincide with the south of the old, and thus unconsciously my axes were turned a quarter round. No plan I could adopt had the least effect in changing the apparent position of the cardinal points. Many a laugh was raised at my expense because of my promptness in pointing in wrong directions; and to this day, after nearly half a century, if I wish to think of directions from that schoolhouse, I am obliged to change my first decisions through an angle of ninety degrees.

Washington City is another place which is entirely out of my system. I entered the city after nightfall. Somewhere between Baltimore and Washington, I lost my co-ordinate axes, so that, when I came to consider directions, Pennsylvania Avenue was turned half round, east was west, west, east; and I had not and have not the least sense of north or south. No study of maps, and no thinking over the subject, has the least effect in arranging things properly.

Boston is another place which is not in my regular system. In that city and vicinity, Washington Street takes the place of my usual east and west axis, and the street that leads to Mount Auburn is the other axis; but these are not in my mind coincident with my principal axes.

Mistakes made at different times have been quite a study to me. Once, in a city which is regularly laid out, going along the west side of a street toward the south, I crossed the street, and turned toward the north upon the opposite side, and went into an office at my right hand. Coming out, and wishing to continue my course toward the south, I really went north, and spent several minutes before I could convince myself of my error. Possibly the mistake arose in the following manner. I lost my axes in passing from the street-crossing to the sidewalk, and turned north when I supposed I turned south; going into the office toward the right, I seemed to go west; coming from the office, I seemed to be going east; and turning to the right, I was to my mind going south.

It is my custom to travel with a map before me; and, on visiting a city for the first time, I secure a plan and study the direction of the principal streets, obtaining correct knowledge of the points of compass. I then carefully classify my acquisitions, and commonly have no difficulty in finding my way without a guide.

MILTON L. COMSTOCK.

Knox college, Galesburg, Ill.

Barn-owls in southern Ohio.

Until recently barn-owls have been of rare or accidental occurrence in this part of the Ohio valley. In the records of the birds in the vicinity of Cincinnati, there were only three specimens noted; and in the record of the birds of Franklin county (Indiana), there has been a vacancy under the head of this species. On Oct. 25, 1883, I was pleased to have a friend bring me a fine male of this species, killed within a half-mile of this town. Soon after this a number of specimens were taken near Cincinnati, at Glendale, where they had taken up their quarters in the town-hall; and others were killed near Jones Station, O. In all, this makes fourteen specimens that I know to have been taken within fifty miles of Cincinnati.

A. W. BUTLER.

Brookville society of natural history,
Brookville, Ind.

Phosphates in North Carolina.

The successful exploration last spring, under the direction of our board of agriculture, of the large beds of phosphatic nodules embedded in marl in New Hanover and Pender counties, started the search for phosphates in North Carolina again. Stray coprolites had frequently been found; but these nodules, forming beds four to five feet thick, and extending through the country for twenty miles or more, suggested an origin different from that of the true coprolite.

Phosphatic rock has recently been discovered in the up-country, which corresponds exactly to the water-worn nodules entering into the calcareous conglomerate of the lower Cape Fear.

In the latter region, about Wilmington, and twenty miles above, we find the nodules embedded in, and forming the lowest layer of, a ground and hardened eocene marl. The nodules show the same fossils, but differ from the marl in the large amount of sand they contain. They vary in composition from fifteen to fifty-two per cent of phosphate of lime, neighboring fragments having often very varied composition, of all shapes, but mostly kidney and egg shaped; perforated; color, gray to greenish black; specific gravity, 2.6 to 2.7. Freshly broken or rubbed, they give the odor of burnt powder characteristic of such phosphates.

Higher up the country, in Sampson, Duplin, and Jones counties, we find the eocene marl above, and the phosphatic rock below, in distinctly separate layers. Here the formation is such as to leave little doubt that the rock is phosphatized marl (according to Holmes's theory), and not true coprolites. It is found in large indented slabs, six to eighteen inches thick, and weighing sometimes several tons, or in

smaller pieces, evidently broken from this, and somewhat worn. This rock presents all of the characteristics and all of the grades of the nodules found in the marl conglomerate, — the same shells, same large amount of sand, and the same appearance. The character of the rock changes gradually here. Between Warsaw and Kenansville it is richest, yielding forty to fifty per cent phosphate, while both east and west it grows more sandy. Between Sampson on the west and Jones on the east we find all the grades of rock which were found in a single place in the conglomerate beds of the lower country. We conclude, therefore, that this conglomerate was formed from extensive breaking up and mingling of beds similar to those seen at the present time in Sampson, Duplin, and Jones counties, and not from stray coprolites, as has been supposed.

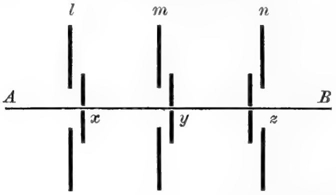
Whether this field will yield any phosphate of more than local value depends upon conditions yet to be determined. CHAS. W. DABNEY, Jun.

N. C. experiment-station, Jan. 2.

Radiant heat.

While it appears that Mr. Fitzgerald's criticism upon Dr. Eddy's hypothesis is conclusive, yet the latter makes a statement in your issue of Dec. 21 which is misleading, since it implies that the device will produce the desired result. Dr. Eddy says, —

"Thus the fact remains, that, although a definite amount of heat from *B* remains entangled in the region *m n*, which is not increased with the lapse of time, there is a continued passage of heat through this region into *B*, that being the very object sought to be accomplished by my process."



Now, the fact is, there cannot be 'a continued passage of heat through this region into *B*,' without permitting the passage of heat from *B* to *A*, by any of the processes described. Granting that heat is entrapped in the space *m n*, it will escape into the space *l m* whenever the door *y* is opened for the passage of heat from *A* into the space *m n;* and the heat so entrapped in the space *l m* will pass on to *A* whenever *x* is opened to admit heat from *A*. This is so plain, that it is only necessary to call attention to the fact, to have it admitted. If the only object sought, as stated in the above extract, was to permit the passage of heat from *A* to *B*, it could be secured at once without any device between *A* and *B*. As originally stated, the object was to transfer more heat from *A*, the colder body, to *B*, the hotter one, than was passed in the opposite direction. The writer has shown in another place[1] that Dr. Eddy's system of moving screens fails to accomplish this result. DE VOLSON WOOD.

Limits of tertiary in Alabama.

The announcement in *Science* (ii. 777) of Professor Johnson's extension of the border-line of the tertiary in Alabama to a position ten miles north of Allenton, and six north of Camden, recalls similar observations made by Alexander Winchell in 1853, and published in *Proc. Amer. assoc. adv. sc.* for 1856, pp. 88, 89. These sub-Claiborne beds he designated 'buff sand;' and the overlying ledge of calcareous grit was traced by him "eight and a half miles north of Allenton, which" was "twenty-five miles farther north than the tertiary beds had been hitherto recognized in this part of the state." The undescribed fossils collected were left with Professor Tuomey, who pronounced them eocene, and held them for description till his death in 1857. A few years later the vicissitudes of war involved the destruction of the Tuscaloosa cabinet by fire. Mr. Winchell's observations were communicated orally in December, 1853, to Professor Tuomey, who noted them down on a manuscript map, from which was compiled the map published in 1858 in Tuomey's (posthumous) second report, edited by Mallet. This places the boundary of the eocene a mile north of Allenton, which, as shown above, is not so far north as Winchell traced the formation. There is, however, nothing in the text of the report on which any change in the older map of this region could be based. Professor Tuomey's observations had been directed to other parts of the state; and Mr. Thornton, his assistant, reports tracing this line through Monroe county, while the map shows it located nine or ten miles north of that county, and, if fully conformed to information in Professor Tuomey's possession, would have shown it seventeen and a half miles north. These statements are only important on the principle of *suum cuique.*

A. W.

Italics for scientific names.

The scientific name of every described plant and animal consists of two or more words: namely, that of the genus, used as a substantive; and the specific name, which follows, and is an adjective adjunct. A species may have a dozen or a hundred common or vulgar names, in half as many languages; but there is only one name in the dead, unchanging, scientific nomenclature. It seems to me that the importance of scientific names, over all others, makes them deserving of a more emphatic type than that of the general text. In the ordinary print — as that of this page of *Science* — any scientific name should be given in italics. Take, for example, the American larch, tamarack, or hackmatack. This tree of our swamps may have many local names, but it has only one in science the whole world over. The emphasis of this fact is largely lost if it is written without an underscore, or printed thus, Larix Americana. It would be only a short step farther to have it larix americana.

It does not follow that names of groups need to be italicized. Thus we can have the order Liliaceae, which contains the genus *Lilium* with its Canada lily (*Lilium Canadense*), the golden-banded lily of Japan (*L. auratum*), and *L. candidum*, or the common white lily. *Quercus, Pinus, Prunus, Ranunculus,* and the thousands of other genera of plants and animals, when used alone, may be set in the common type of the page, and stand thus, — quercus, pinus, prunus, and ranunculus; but I do not like it. Many of the generic names are derived from proper names, as Linnaea, Magnolia, Tournefortia, Begonia, etc.; and these certainly should begin with capitals. When, however, the name of any genus is the common name of all the plants in that genus, it is reasonable to use it without a capital, when employed in a general way. We may say of a plant, it is a fine begonia, or a stately magnolia, or a delicate linnaea, and the absence of

[1] *American engineer*, Chicago, 1883, Jan. 12, Feb. 9, 23, and April 6; also *Journ. Frankl. inst.*, May, 1883, 347.

capital letters is well enough, even though the names have been derived from proper names; but, if we say it is a choice specimen of *Begonia Rex*, the case is different. The word 'begonia' now becomes a part of the scientific name of a species of plant. In the same manner the stately magnolia may be *Magnolia glauca* or *M. grandiflora*.

Science does not use emphatic type for the scientific names of genera or species, and doubtless for good reasons. I should like to learn what views the editor and other authorities in scientific nomenclature hold on the above subject. BYRON D. HALSTED.

New York, Dec. 31, 1883.

[We do not agree with our correspondent in his estimate of the value of the scientific names of plants and animals. They are a simple convenience, and have no higher value; and the use of italics for their proper mission — that of emphasis, or as catch-words — is lost if the page bristles with italics having other meaning.]

The skidor in the United States.

In *Science*, No. 44, mention is made, in Nordenskiöld's account of the Greenland inland ice, of the 'skidor,' or Norwegian snow-shoe. It may be interesting to your readers to know that it is the snow-shoe most commonly used in Colorado. It is much preferred to the Canadian or web snow-shoe, and in the mountains in winter is often the only means of getting about from place to place — as from the mines on the mountains to the towns, and from one small mining town to another — when there is not enough travel to keep a road open through the deep snow. I know of one case in which a daily mail is carried twenty-five miles on snow-shoes; two men having the route, each making a single trip in a day, but going in opposite directions. The motion can hardly be called 'running,' as it is in the footnote on p. 737, as the shoes are not lifted from the surface of the snow at all, but slid forward at each step, the foot being raised slightly at the heel as in commencing a step in ordinary walking. The shoes that I have seen are from six to eight feet long, and about four inches wide. A pole about seven feet long is used as a guide and support, especially in sliding down hill, when a tremendous pace is often attained on a long slope. E. R. WARREN.

Colorado Springs, Jan. 1.

Standard thermometers.

In your editorial in this week's *Science* you quote the report of the chief signal-officer of the army, implying that a sensible difference exists between the theoretical standard thermometer adopted by this observatory and that of the International committee of weights and measures, and that the signal-service of the army has adopted a new standard thermometer more nearly agreeing with the latter.

I should be very greatly obliged to the chief signal-officer if he will anticipate the regular course of publication of the scientific work of his office, and give to the scientific public the results, at least, of the work from which it is concluded that the signal-service of the army has reached a nearer approximation to the standard thermometer of the International committee.

I have no doubt that there is a small difference between the standard air thermometer and the particular mercurial standard adopted by this observatory as its practical representative, at points distant from the freezing and boiling points; but, as our own standard has never been compared with any air standard in the possession of the signal-service of the army, I shall be quite interested to see the work by which it is concluded that there exists a sensible difference between the two. LEONARD WALDO.

Dec. 31, 1883.

Romalea microptera.

In 1879, in Alabama, I had many opportunities for observing the habits of the 'lubber grasshopper;' and, if my memory serves me, my observation showed that the hissing referred to by Capt. Shufeldt (*Science*, ii., 813) is due in large part to the forcible expulsion of air from the thoracic spiracles. It was always noticed on the occasions referred to by him, but at no other time. W. T.

Synchronism of geological formations.

I cannot agree with Professor Heilprin in the line of argument adopted in his letter to *Science* of Dec. 21, based, as it mainly is, on the assumed non-occurrence of 'evidence of inversion.' Professor Heilprin asks, "Why has it just so happened that a fauna characteristic of a given period has *invariably* succeeded one which, when the two are in superposition all over the world (so far as we are aware), indicates precedence in creation or origination, and *never* one that can be shown to be of a later birth?"

In reply I would say, that some years previous to Professor Huxley's address on this subject, Barrande, in his 'Système Silurien de la Bohême,' had shown such evidences of inversion to exist in the Silurian formation of Bohemia; and though many geologists and paleontologists disagreed with Barrande at that time, as to his theory of 'colonies' by which to account for the facts, yet none could dispute the facts cited by him. If we now turn to the old red sandstone of Scotland, we find still further evidences of inversion of like kind; for, while the crustacean genus Pterygotus, common to both the upper Silurian and lower old red sandstone, has been recently found also high up in the middle series of this formation, the carboniferous limestone shells, Productus giganteus, P. punctatus, Spirifer lineatus, and others, have been found in the old red sandstone far below the fish genera Pterichthys and Holoptychius, so characteristic of the upper old red division. Though there appears to be no reason why such instances of inversion should not have occurred over and over again, one can readily understand why, through the imperfection of the geological record, and the comparatively small fraction of the earth's surface which has been systematically examined, their occurrence is almost unknown.

With reference to the doctrine of migration, I judge, that, from Professor Heilprin's argument, we look at the matter from two different stand-points. He apparently takes no account of the generally accepted view of biologists, that, while organic development has been closely similar in all parts of the world, the rate at which it proceeded has varied within the widest limits, even in adjacent regions. I cannot help looking on the various formations as the records of that development; and, judging of the past distribution of life on the earth from what we at present see before us, I am forced to believe that identity of organic contents in widely separated strata, instead of being evidence of chronological contemporaneity, is exactly the reverse.

Instead of encroaching further on your valuable space, I would refer to Prof. A. Geikie, who, in the current issue of the Encyclopaedia Britannica (9th

edition, subject geology, part 5), gives exactly that view of the matter which I consider the logical basis on which Professor Huxley rested his argument, and which recent researches have in no way tended to upset. E. NUGENT.

Pottstown, Dec. 27, 1883.

SIR CHARLES WILLIAM SIEMENS.

CARL WILHELM SIEMENS died in London on the 20th of November last, at the age of sixty. This distinguished man, better known to the people of Great Britain and the United States as Charles William Siemens, one of eight sons of Ferdinand Siemens, was born at Lenthe, near Hannover, April 4, 1823. He was one of a family of men of science several of whom have become well known by their success in the invention and introduction of improvements and modification of standard methods of engineering and metallurgical work. Among these, his brother, Ernst Werner Siemens, is the most famous. The two brothers have worked together, with frequent assistance from a younger brother, Friedrich, in nearly every field of applied science. They have been most successful in the departments of metallurgy and electricity.

The elder brother, Ernst, entered the army of Prussia, joining the artillery; and Carl was sent to the University of Göttingen. Carl received his preparatory education at the Gymnasium of Lübeck and in the Art school of Magdeburg, near what was formerly the home of Otto von Guericke. After graduation from the university, he entered the Stolberg engineering-works, in 1842, as an apprentice, but remained only a year, leaving for the purpose of going to London to patent and introduce his first invention, the 'differential governor' for steam-engines, and a method of silvering devised by his brother Ernst. He settled in London, opening an office as civil engineer, and making that city his home, becoming 'naturalized' in 1849, but frequently visiting Germany to meet his brothers, who finally joined him in business.

In 1846 the brothers began the study of methods of economizing in the use of fuel in metallurgical operations demanding high temperatures; and the result of their labors, in course of time, was seen in the invention of the Siemens regenerative furnace, — an invention which has since revolutionized the methods of production of steel and of heating iron, and which is still modifying all the industrial operations dependent upon the attainment of maximum heat in furnaces; such as the manufacture of glass, and the reduction of ores of zinc and other 'useful' metals. In 1849 the brothers William and Werner, as they came to be called, attracted the attention of all who were interested in the applications of science by the announcement of their invention of a method of 'anastatic printing,' modifications of which have now become generally introduced for the production of the simpler kinds of line-engravings. This invention greatly interested Professor Faraday, and he was very soon sufficiently well convinced of its value to volunteer to describe it in a lecture before the Royal institution. His helpful aid was one of the most effective means of making the talented young inventors known and of giving them a start in a career bringing them continually increasing fame.

Siemens next turned his attention to the newly announced dynamical theory of heat, and in 1847 adapted a 'regenerator' to a superheated steam-engine. Modifications of the governor for controlling the motion of clock-work were proposed by him at nearly the same time, and his 'chronometric governor' has been long in use on the instruments of the Greenwich observatory. In 1851 he brought out his water-meter, — an instrument in which was a screw with its recording or indicating mechanism sealed in a chamber having a glass window, through which the readings could be made, and so free from friction that it gave most accurate measures of the flow. The regenerative furnace now began to take such shape that the brothers found it to their interest to devote their attention to that; and in 1856 they worked the invention into such form that they could see in it the promise of complete success. By the year 1861 they had patented some of its most essential features. The inventors succeeded in raising the necessary capital, and erected their furnace in works at Birmingham in 1866, and made steel by their process, which was exhibited at Paris at the international exhibition of the following year. The primary object held in view by the inventors was the manufacture of steel directly from the ore. In this they were less successful than in the making of the steel by mixture of wrought-iron scrap with cast iron on the hearth of their reverberatory furnace. This last-named process has become a well-known method of producing the soft ingot-irons misnamed steels, 'mild' or 'low' steels, which materials are now so exclusively adopted by many makers of steam-boilers and of rails. Such steel is steadily driving puddled iron from the market: it is called, sometimes 'Siemens,' and often 'Siemens-Martin' steel; the first attempts to manufacture steel by this method having been

successful in Great Britain through the efforts of Siemens, and in France by application of the Siemens furnace to this use by Martin. The Landore steel-works, started at Landore, Wales, in 1868, were the first to make steel by the Siemens methods on a considerable scale; and it was there that the great engineer conducted the more successful experiments of later years.

The tastes and the studies of the brothers led them, at an early date, to the examination of the lines of development of applied electricity. In 1848, or earlier, they became interested in telegraph-work, and both Charles and Werner began to apply their inventive talents to the production of telegraph instruments and apparatus of various kinds used in electrical measurements. Ten years later the firm of Siemens & Halske, of Berlin and of London, was formed; and they soon became the most extensive manufacturers of electrical apparatus in Europe. They began the construction of submarine telegraph-cables at an early date, and established, later, factories at Woolwich, England, and in Berlin and St. Petersburg. They finally built up their business to such an extent that it became necessary to have a large steamer constantly and exclusively employed in laying down their cables. The Faraday, named for their early friend, was constructed under the direction of Dr. Siemens, and has been since employed in the laying of the principal long cables under the Atlantic, in the Pacific, and under parts of the Indian Ocean. From this branch of electrical work to that of electric lighting was but a short step for these great men; and they have, during the past half-dozen years, been as well known for their success in the introduction of the Siemens system of lighting, and for inventions of apparatus and machinery in connection with it, as for their earlier inventions in other fields. All successful dynamo-electric machines have the Siemens armature; that method of winding, and its peculiar form, being especially fitted for introduction into the modern forms of dynamo. Their lamp has proved to be one of the best in use; and a multitude of details, worked out with characteristic ingenuity and care, has given their system, as a whole, a completeness, and a degree of perfection in operation, which have contributed in no small degree to the fame of Dr. Siemens. The wonderful combination of scientific knowledge with practical experience and information possessed by Siemens made him eminent in every department of application to which he chose to turn his attention. His success in raising capital for large operations was due to

his personal character, however, quite as much as to his reputation as a scientific man and a talented engineer. The firm of Siemens & Halske was thus able to secure concessions from the Austrian government for probably the most extensive system of elevated electric railways yet projected, and has begun its construction in the city and suburbs of Vienna. The success of such railways at the electrical exhibition was such as to give great confidence that such railway systems will supersede those now in operation by steam.

Physicists will honor Sir William Siemens as the inventor of the 'electric resistance pyrometer,' to which is so closely related Professor Langley's 'bolometer.' They will remember him as the discoverer of the influence of the electric light on vegetation, and as the inventor, also, of the 'bathometer' and the 'attraction meter.'

His papers are numerous, and many of them important: they usually relate to subjects closely connected with his work and his inventions and discoveries.

The greatest commercial and financial successes of Siemens and his partners have been in their telegraph-cable work, and, above all, in the introduction of the Siemens system of generating heat for metallurgical operations. This system is estimated to save, in the steel-works of the country, thirty to fifty per cent of the fuel used by earlier methods, to permit an increase of work done per furnace used in nearly equal proportion, to give a finer product in consequence of the purity of the flame, and many incidental advantages. It has saved to the people of the United States alone between twenty-five and thirty millions of dollars during the comparatively few years that these furnaces have been in general use.

The name of Charles William Siemens is honored in every civilized country; and every nation capable of appreciating the good work done by him has given expression to this appreciation. The British institution of engineers admitted him to membership many years ago, and made him a member of its council. He was awarded the Telford medal for his inventions, a distinction only accorded to the greatest of engineers for the greatest of inventions or constructions, and was given the Royal Albert and the Bessemer medals later. He was made a fellow of the Royal society of Great Britain, a member and a president of the British association for the advancement of science, and a member of the councils of both those societies. He was elected president of the British institution of mechanical engineers and of the Society of telegraph engineers, and was made a member of many foreign societies, both scientific and engineering. He was an honorary member of the American philosophical society and of the American society of mechanical engineers. He was given the degree of D.C.L. by Oxford, and of LL.D. by the universities of Dublin and Glasgow. He received many decorations, one of the latest of which was that just offered him by Austria at the Vienna electrical exhibition. He was knighted, a few months before his death, by Queen Victoria; and his sudden and premature death — for he was a man physically strong and sturdy, and evidently constructed for an octogenarian — did not occur so early as to deprive him of more numerous and greater honors of this formal sort than usually fall to the lot of even the greatest of men.

Sir William Siemens was a man of large, well-shaped frame, muscular rather than fat in his early years, but inclining to stoutness as he grew old. He had a noble, well-shaped head; large, strong, and characteristic features, which were mobile, kindly, and unusually expressive. His manners were those of a man who had grown to know his place in the world and to feel sure of a high place among men, quiet, composed, confident, without being in the slightest degree self-asserting, or at any time disagreeable to his associates, to friends, or to competitors in business. Equally at home in the courts of royalty, in the halls of science, and in the offices of business-men, he impressed every one whom he met with his strength, talents, knowledge, and *savoir faire*. He numbered among his friends the great in every department, — statesmen, men of science, engineers, inventors, and capitalists. He was equally honored and beloved by all, and loved equally well to entertain them all in his fine London mansion and in his beautiful country place, in both of which hospitable homes he met his guests with a plain, simple, and kindly greeting and conversation, which made them at once at home, and at ease with their entertainer. One of his most pleasing powers was that of adapting himself to the temperament and the methods of conversation of those whom he met, whatever their rank in life or their personal interests and lines of thought.

In his death is lost, to his intimates, one of the truest and best of friends; to his employees, a kind benefactor; to science, one of her most splendid workers; to the arts, one of the greatest among their promoters; to the world, one of the noblest among its few great benefactors.

ROBERT H. THURSTON.

THE RED SKIES.

THE remarkable atmospheric phenomenon which has recently attended sunrise and sunset, has attracted great attention not only from the general public, but from scientific men, who have endeavored to give a satisfactory explanation of it. Similar appearances have been noted in former years; but they have been of limited extent, and attributable to local causes. The distinguishing characteristics of the present manifestation are its enormous extent, since it has been observed over nearly the whole earth, its persistence, and the fact that the times of its first appearance have varied in different countries, thus suggesting a progressive motion.

In the United States the reports of observers of the signal-service show that its earliest appearance was in October. At Pensacola, Fla., on the 8th, the phenomenon was observed at both sunrise and sunset. Near the middle of the month it was noted along the southern border from southern California to the Gulf of Mexico. At the close of the month it was observed in great brilliancy in the southern and south-western states. In the more northern portions of the country, during October, the sunsets were characterized by unusual brilliancy; but the peculiar 'afterglow' which marked the later appearances was not noted. In the early part of November the phenomenon was still observed on a few days in the south and west; but after the 20th it appeared in its full beauty over nearly the whole country. In New England, the Atlantic, Gulf, and central states, the lake region, the north-west, and along the Pacific coast, the phenomenon was observed, beginning at various dates after the 21st, according to the weather conditions of the different localities. The 27th was the date in which the appearance was first especially marked in the eastern states. Since that date, to the end of the year 1883, the skies have been characterized by the same brilliancy, whenever the weather conditions have been favorable to its observation; the 27th and 28th of December revealing the appearance in the eastern section of the country to a marked degree.

The sky seems to have had essentially the same characteristics wherever the phenomenon has been observed. In Europe and America, however, if we may judge from the published descriptions, the green or blue appearance of the sky has been less noticeable than in India, where the earliest observations were made. In this country the 'afterglow' has been ruddy, with at times an orange or greenish tint. The observer at Memphis, Tenn., under date of Oct. 30, writes, "For more than one hour after sunset there was in the west a segment of red light, whose intensity and brilliancy appeared equal at all points in the segment. The position (altitude?) of the segment was about 30°, azimuth 45° to 120°." On Oct. 31 the appearance was similar, "except that in the north-east quarter of the segment a few converging bands, apparently dark, entered the segment from a clear sky. While no stars were visible in the illumined part of the segment, they were visible in all other parts of the sky, and also in the bands, which, it appears, were dark in contrast." At Washington, on Dec. 29, a ruddy arch arose in the early morning, and was about 25° high an hour and ten minutes before sunrise. Soon after, the usual twilight arch appeared, also of a ruddy tint; and the two were seen simultaneously, the former losing its outline, and growing paler as it became tranfused over the sky. During the day, the material causing the appearance was plainly visible as a white haze surrounding the sun to a distance of about 30°. At sunset on the 27th and 28th the phenomena were as at sunrise, but in reverse order, the secondary glow lasting an hour and three-quarters after sunset. While the glow at the end of December is perhaps not as intense in color as when first seen a month earlier, it is the same in other respects. It has been described in profuse detail in the daily press; and several English magazines, notably *Nature*, have devoted much space to it.

Three different hypotheses have been advocated to explain the phenomenon, assigning its cause to aqueous vapor, meteoric and volcanic matter respectively. It is undoubtedly atmospheric, and due to the presence of some matter in unusual quantities. The persistence of the phenomenon, and its great extent, are objections to the view that it is due to aqueous vapor. There would certainly have been, ere this, extensive precipitation, were aqueous vapor the cause; but reports indicate nothing abnormal in the rainfall. Moreover, the glow has been most noticeable when the air has been driest: it has been a characteristic of the cold, dry weather, which attends areas of high barometric pressure. In addition, the spectroscope has confirmed the indications of the psychrometer. The pocket-spectroscope shows a very weak rain-band, and a strong development of the bands designated by Piazzi Smyth as a and δ, and ascribed by him to 'dry air,' the

latter known especially as the 'low sun-band.' The same result has been obtained in England and in America. A careful examination of the spectrum with a powerful grating spectroscope, made at sunset on Dec. 28, showed that the aqueous lines were feeble; and the spectrum, at its disappearance, was much farther extended towards the green than is usual in a clear sky. From all these considerations, it seems that the hypothesis of an excess of aqueous vapor in the atmosphere is not tenable.

It seems not unreasonable to suppose that the upper regions of the atmosphere have received from some source an accession of light matter which reflects the sunlight. Of the two suggested sources, — meteoric dust encountered by the earth in its progress, and volcanic matter projected to an enormous height, — either would be a satisfactory explanation. The former would seem in itself the more reasonable, were there not in this instance special considerations which give additional weight to the latter. Both of these hypotheses have been independently suggested by various writers. Mr. Ranyard advocates the meteoric view in *Knowledge* for Dec. 7, and Mr. Lockyer the volcanic theory in the London *Mail* of Dec. 10, and current numbers of *Nature*. English scientific men have shown great interest in this investigation; but few references to it have been made, as yet, in the publications of other countries.

It will be of interest to classify the dates at which the atmospheric phenomenon has been earliest observed in different countries. The following table contains a list of the dates and countries, with the approximate distance and direction of each country from the Straits of Sunda, in which occurred the tremendous volcanic outburst of Aug. 26. It should be noted, that, while the dates given have been collated from the best evidence at hand, there is a possibility that they may be too late in some cases, either from the fact that earlier observations have not been reported, or were not made owing to unfavorable weather: they must therefore be taken as only approximately accurate. A few have been derived from general statements in which the exact dates were not mentioned.

This table has been derived mainly from English periodicals and from the records of the U. S. signal-service. The important references to New Ireland and the Hawaiian Islands were received by letter from Mr. S. E. Bishop of Honolulu, who has also obtained from shipmasters the information that the phenomenon has been extensively seen on the Pacific Ocean since Sept. 1. It is also reported from China, but no date is assigned.

Date.	Country.	Distance and direction from Straits of Sunda.	
1883.		*Miles.*	
Aug. 28	Rodrigues	3,000	S.W.
28	Mauritius	3,500	S.W.
28	Seychelles	3,500	W.
30	Brazil	10,500	W.
Sept. 1	Gold Coast	7,500	W.
1	New Ireland	3,000	E.
2	Venezuela	12,000	W.
2	West Indies	12,000	W.
2	Peru	13,000	W.
5	Hawaiian Islands	7,000	N.E.
8	Southern India	2,000	N.W.
8	Ceylon	2,000	N.W.
15	Southern Australia	3,000	S.E.
15	Tasmania	4,000	S.E.
20	Cape of Good Hope	6,000	S.W.
Oct. 8	Florida	13,000	N.W.
19	California	9,500	N.E.
20	Southern United States	11,000	N.E.
Nov. 9	England	7,500	N.W.
20	Turkey	7,000	N.W.
21	United States	11,000	N.E.
25	Italy	7,000	N.W.
26	France	7,500	N.W.
28	Germany	7,000	N.W.
30	Spain	8,000	N.W.
30	Sweden	7,500	N.W.

An examination of this table shows at once the wide-spread character of the phenomenon, and its progressive motion. It is impossible not to conjecture a connection with the volcanic eruption in the Sunda Straits, by which, on Aug. 26, the island of Krakatoa disappeared wholly from the face of the earth. The terrible nature of this outburst can hardly be realized: the sky was darkened for several days, the noise was heard two thousand miles, magnetic disturbances were noted, the tidal wave was distinctly felt at San Francisco, and the atmospheric disturbance was sufficient to cause marked barometric fluctuations, which were noted by the barographs on the continent, in England and America, for several succeeding days. Coincidence in dates is not a proof of a connection between the atmospheric and the volcanic phenomena; but it is certain that the former were first observed near the scene of the latter, and that similar atmospheric effects have been heretofore recorded over limited areas in connection with volcanic outbursts. Assuming the origin of the atmospheric effects to be the volcanic eruption, the table shows an extremely rapid progression in both an easterly and a westerly direction, — the former over the Pacific Ocean, the latter over the Indian and Atlantic oceans, to South America and the West Indies. Mr. Lockyer considers that the latter continued westward to the Hawaiian Islands, and does not regard an eastward pro-

gression at all; but the later evidence from the Pacific shows that the phenomenon was seen several thousand miles east of Java on Sept. 1. This extremely rapid progression has been mentioned as an objection to the volcanic theory, but it is not impossible to believe in its truth; and we know little or nothing of the motions of the higher strata of the atmosphere. Besides, it is not necessary to reckon from Aug. 26, the date of the volcanic catastrophe; for the volcano had been in eruption since May 20, and the steamship Siam, on Aug. 1, in latitude 6° south, longitude 89° east, sailed for more than forty miles over floating pumice. There seems also to be a well-marked southern progression, though the dates for Australia and Tasmania are probably too late.

It is difficult, however, to trace with certainty a progression northward. The October appearances in the United States, and the November appearances in the United States and Europe, if the result of the August eruption, show a rate of progress very much slower than that in an easterly or westerly direction. There seems also to be a gap in the dates; for, with the exception of the three dates in October, there is a September group covering a large territory, and a similar group in November over a different territory. The October records, which are all in the United States, are definite, but few in number. During this month, and up to the 20th of November, there was a well-marked brilliancy in the sunrise and sunset colors over a large portion of the United States, but it did not possess the marked intensity which seemed to suddenly begin after the 20th. It is possible that the sudden increase in the latter part of November, which was noted both in America and in Europe, was due to the arrival over these countries of the volcanic matter which had been moving slowly northwards for ten weeks; and the October appearances may have been either the sequel of the progression towards the West Indies in September, or the forerunner of the later, more marked appearances.

Another explanation, in consonance with the volcanic hypothesis, may be given. The eruption in the Sunda Straits is not the only volcanic outburst of great intensity which has recently occurred, though it has been better known because occurring in an inhabited region. Meagre accounts have been received of a great outburst in Bering Sea, to which brief allusion was made in *Science*, No. 46. The October weather review of the signal-service contains a letter from Sergeant Applegate, the observer at Unalashka, Alaska, in which he says, referring to some sand which fell in a rain-storm of Oct. 20, —

"This sand is supposed to have come either from the Mukushin, or the new volcano adjacent to Bogoslov. The former is at a distance of about nineteen miles south-west, but for years has only issued forth smoke or steam. The latter is a new one, which made its appearance this summer, and burst out from the bottom of Behring Sea. It has been exceedingly active, as it has already formed an island from eight hundred to twelve hundred feet high. According to the report of Capt. Anderson, the discoverer, who sails one of the company's vessels, and who went within two thousand yards of it, it presents a most magnificent sight. The fire, smoke, and lava are coming out of many crevices, even under the water-line. Large bowlders are shot high in air, which, striking the water, send forth steam and a hissing sound. Bogoslov is about sixty miles from here, in a west direction. The new volcano is about one-eighth of a mile north-west of it."

This makes the position of the volcano, latitude, 54° north; longitude, 168° west. The San Francisco *Chronicle* of Nov. 23 contains a more detailed report, but adds nothing essential to the above description. As this extensive eruption has been taking place for some months, it is not improbable that the atmosphere has received a large accession of volcanic material from this source also; and possibly to this cause may be due, at least in part, the appearance of the sky in November.

It would seem as if an examination of the dust particles brought to the earth by rain or snow would furnish final proof as to the source of the matter causing the phenomenon, provided that it is not wholly above the influence of the descending precipitation. The force of gravity would certainly eventually bring to the earth portions of the material. It is not uncommon for meteoric matter to be found in the analysis of freshly-fallen snow; and an anonymous writer in the *New-York herald* of Dec. 29 implies that the late snows have given indications of meteoric matter. This, if verified, would tend to confirm the truth of the meteoric theory; but results of quite a different character are announced in *Nature* for Dec. 20, which has been received since this article was begun. An analysis of fresh snow, made by Mr. McPherson in Madrid, Spain, revealed the presence of "crystals of hypersthene, pyroxine, magnetic iron, and volcanic glass, all of which have been found in the analysis lately made at Paris of the volcanic ashes from the eruption of Java." Similarly a microscopic examination of the sediment from a violent rain-storm on Dec. 13 was made at Wageningen, Holland, by Messrs. Beyerinck and Dam, and compared with a sample of ash from Krakatoa.

It was found that "both the sediment and the volcanic ash contained, (1) small, transparent, glassy particles; (2) brownish, half-transparent, somewhat filamentous little staves; and (3) jet black, sharp-edged, small grains resembling augite. The average size of the particles observed in the sediment was of course much smaller than that of the constituents of the ash. These observations fortify us in our supposition, expressed above, that the ashes of Krakatoa have come down in Holland."

These analyses certainly tend to confirm the volcanic hypothesis, though it is interesting to note that some of the substances found by Mr. McPherson are also characteristic of meteoric matter. The evidence thus far accumulated seems to point positively to the truth of the volcanic hypothesis. The opponents of this view dwell upon the improbability of so much matter being thrown up to such a great height, and of its remaining so long a time in the atmosphere. But the magnitude of the Java eruption has certainly not been overrated; and the amount of material thrown into the atmosphere from this source alone is probably sufficient to account for the observed effects. If we add the amount from the Alaskan volcano, there is less reason to doubt the ability of the hypothesis to account for the quantity of material required. The objection on the ground of the persistence of the phenomenon has been met by Messrs. Preece and Crookes on electrical grounds. If the matter thrown up is charged with negative electricity, it would be repelled from the earth, and its particles would repel each other, thus causing the rapid dissemination of the material in the atmosphere, and its retention for an indefinite period. The decline of brilliancy has been slow during the time it has been observed in this country. In the Hawaiian Islands it is still a marked phenomenon, after a lapse of several months. We may therefore expect that for some time to come we shall observe it under favorable weather conditions, but that it will gradually become less prominent until it is known only as a fact of past history.

W. UPTON.

Washington, D.C., Jan. 1, 1884.

WHIRLWINDS, CYCLONES, AND TORNADOES.[1]—VII.

WE are now prepared to consider and explain the actual distribution and motion of cyclones.

The limitation of violent cyclones to the ocean is natural enough: the level surface of the sea allows a great accumulation of warm, moist air before the upsetting begins, and permits the full strength of the winds to reach a very low altitude. On land the air never waits so long as it may at sea, before upsetting; it never becomes so moist; and, when in motion, the inequalities of hill and valley hold back the lower winds by friction. On land the strong part of the cyclone is relatively higher than at sea, as the records of mountain observatories show; and we know less of it.

No violent cyclones are known to have occurred within four hundred miles of the equator. Here, — where the air is warm, quiet, and heavily charged with moisture; where heavy, quiet rains are frequent; where the conditions which have been mentioned as essential for starting a cyclone are of common occurrence, — cyclones are nevertheless unknown. They occur often enough, however, in the embryonic form of thunder-showers, but they never reach the adult stage; and this must be because at the equator the deflective effect of the earth's rotation is zero, and the inrushing winds are allowed to move directly toward the low-pressure centre and fill up the depression, instead of increasing it by their deflection and their centrifugal force. From this we learn, that, while warmth and moisture may be sufficient to begin a cyclone, they alone cannot maintain it. There would be no violent cyclones if the earth stood still.

It might be inferred from this that cyclones should increase in frequency and intensity as we recede from the equator toward the poles, for in the higher latitudes the earth's deflective force is known to increase. It is true that storms are much more frequent in high latitudes than near the equator; and this is very likely due to the greater ease with which moderate indraughts are here deflected so as to produce a central baric depression. But the more intense storms are all within thirty or thirty-five degrees of the equator, because, in more polar latitudes, the air is not warm or moist enough to co-operate effectively with the deflective forces, and produce violent winds. It has already been explained that a rising column of moist air cools more slowly than one of dry air; and on this there was shown to depend much of the greater energy of oceanic storms over that of desert whirls. It should now be added, that, of two ascending currents of saturated air, the warmer will rise much more vigorously than the cooler: hence the warm, saturated air of the tropical sea breeds hurricanes, cyclones, and typhoons of greater strength than the

[1] Continued from No. 45.

storms that are raised in temperate latitudes, although the latter outnumber the former on account of the more effective aid of the earth's rotative deflection at a distance from the equator.

We must next examine the cause that determines the season of cyclones, throws them near the western shores of their oceans, and requires them to move toward or parallel to the eastern coast of the adjoining continents. This will be found to depend on the general circulation of the winds, as may be seen on examining the air-currents of the North Atlantic at the seasons of the most frequent hurricanes. Poey has compiled a list of hurricanes observed in the West Indies since 1493, amounting to three hundred and sixty-five in all; and of these, two hundred and eighty-seven, or nearly eighty per cent, occurred in July, August, September, and October. Now, these are the very months when the equatorial calms or doldrums are farthest north of the equator, and hence in a position to allow the embryonic storms to develop by the aid of the earth's deflective force. At other seasons the trade-winds extend nearer to the equator; and then, in a latitude where storms might grow if once started, the steady blowing trades prevent even the formation of an embryo. The few storms that occur at these other seasons have less evident causes: they may arise in conflicting winds, and may be fairly thrown among those unexplained effects that we call accidental. Once formed, the storm is carried along, by the general circulation and by the strong winds, toward the West Indies. On nearing them, it moves to the north-west and north, mostly because branches of the trade-winds here turn to that direction in the cyclone season, so as to avoid the mountains farther west, and to run up over the warm land of our country; partly because of the continual polar tendency, or excess of deflection on the northern side of the storm. Even if the general surface-winds do not blow along the storm-tracks, it is very probable that the upper current, returning from the equatorial calms toward the prevailing westerly winds of the temperate latitudes, follows a course closely parallel to the average of the cyclone paths; and there is good reason to believe that the upper winds have a great control over the storm's progression. If the storm should begin on the eastern side of the Atlantic, it would probably be held so near the equator by the indraught of the trade-winds that it could not reach a destructive size. The greater Atlantic hurricanes are therefore those that begin in the western part of the calms or doldrums when they are farthest from the equator, and then, passing along their curved paths, take the West Indies and our south-eastern coast on their way up into the North Atlantic. As they go, their diameter greatly increases; because they draw their wind-supply from longer distances, and because in the temperate latitudes the earth's deflective force is greater than it was in the tropics. But with this increase in diameter there comes a diminution of intensity, because the winds are cooler and contain less vapor; and finally the storm dies away when the weakened updraught at the centre fails to throw its overflow outside of the limits of the whirl. The storm is then not working its way: friction will soon cause the winds to cease, and the disturbance will come to an end.

As for the South Atlantic, it possesses no cyclone region, because the doldrums never extend south of the equator. In spite of the sun's passing to the south in winter, the heat-equator, which determines the position of the doldrums, hardly passes the geographic equator in the Atlantic; the excess of land in the northern hemisphere, and the strong general winds of the southern hemisphere, keep it back: and so the South Atlantic has no cyclones such as occur in all the other oceans. The cyclones of the Pacific and Indian oceans depend on conditions such as have been described for the North Atlantic. They are commonest in the southern hemisphere in February for the same reason that they are most frequent in the northern in the months about September.

We have now considered the origin and motions of the cyclones and hurricanes, and the regions of their occurrence. This study has its highest aim in giving timely warning of their approach and in devising rules for avoiding them. If their tracks lay over the land, the telegraph could in all cases give sufficient notice of their coming, for their motion is slow; but they are at sea during much of their life, and the questions now arise, How can the captain of a vessel gain the first intimation of their coming? and, What should he best do to avoid their dangerous centre?

The storm's earliest effect on the atmosphere is shown by the barometer. It is ordinarily stated that the first effect is seen in a diminution of pressure; but it is very probable, both from theory and from careful observation, that a slight abnormal increase of pressure precedes this diminution. The tropical seas, where cyclones are most violent, have, as a rule, very small and very rare irregular changes in at-

mospheric pressure; and careful watching will pretty surely show a rising barometer, as the annulus of high pressure that surrounds the storm (see fig. 8) moves over the observer. The weather may still be clear, and the wind moderate and from its normal quarter; but this change in the glass demands renewed watchfulness. Let us suppose that such an observation be made on board a vessel lying east of the Lesser Antilles. The chart shows the captain that he is in the stormy belt. He may be directly in the path of the advancing storm, where he will feel its full violence; and he must make the best of his way out of it. Following the rising pressure, three other signs of increasing danger may be observed, — first, faint streamers of high cirrus-clouds may be seen, slowly advancing from the south-east to the north-west, or from the east to the west, in the high overflow from the storm's centre; this unpropitious change may accompany the rising of the barometer, or may be first seen when the barometer is highest: second, the barometer begins to fall, slowly at first, but more and more quickly when it reaches and passes twenty-nine inches; the vessel is then within the limits of the storm: third, the wind has shifted so as to blow from a distinctly northern quarter, and its strength goes on increasing; this is the indraught, blowing spirally toward the centre. There is then no longer any question that a storm is approaching; and as soon as a heavy bank of clouds makes itself seen, moving southward across the eastern horizon, then the central part of the storm is in sight. These clouds are the condensed vapor in the rising central spirals, and rain is falling from them. In deciding on a course to be pursued, the first point to be determined is, where is the storm's centre? That being known, its probable path can be laid down with considerable certainty in this part of the ocean; and then, perhaps, the greatest danger may be avoided. But here a very practical difficulty arises. To find the direction of the storm-centre, we must know the incurving angle of the wind's spiral, — the angle of inward inclination that it makes with a circle whose centre is at the storm's centre. The earlier students of the question — Dove, Redfield, Reid, and Piddington — considered the course of wind to be concentric circles, or inward spirals of very gradual pitch; so that they said the inclination of the wind is practically zero, and a line at right angles to its course must be a radius leading to the centre. Later studies showed this to be incorrect. The inclination of the wind inward from the circle's tangent was found to vary from 20° to 40° or 50°: but it was thought that this inclination was symmetrical on all sides; so that, with an average inclination of 30°, the storm's centre must always bear 60° to the left of the wind's course. Finally, the most recent results seem to show that the wind's course is neither circular nor symmetrically spiral; that the wind's inclination is very distinctly different in different latitudes, on different sides of the storm, in the different conditions found on sea and land, at different distances from the centre and at different altitudes. In so complicated a case, much judgment will be required to find where the storm-centre lies.

First, in regard to the latitude of a storm. Without considering its progression, the nearer it is to the equator, the less its indraught winds will be deflected to the right by the earth's rotation, — the more nearly radial they will be. But, as they move with much energy, they will gain in rotary motion rapidly as they approach the centre, and there will whirl around in almost perfect circles. Storms in low latitudes will therefore tend to have a comparatively small but violent central whirl, only one or two hundred miles in diameter, within which the winds may be almost circular; and the centre will there be nearly at right angles to the wind's course. Farther from the centre, the winds would be nearly radial; and, if storms could arise on the equator, they would have simply radial indraughts with a very small central whirl. On the other hand, in the temperate zone the inflowing winds will be strongly deflected to the right of their intended path; and they must depart widely from a direct line to the centre of low pressure, forming a whirl often one thousand miles in diameter: but, unless they inclined inward at a distinct angle, it would take them too long to reach the centre, and their strength would be lost in overcoming friction on the way. Their average inclination is therefore well marked. The steeper inclination of the winds close to the centre, observed in some northern storms (Toynbee), may be an effect of the tornado action in the cyclone, yet to be described.

Second, in regard to the sides of the storm, as affected by its progression. The inclination will generally be less than the average in front and on the right, and greater in the rear and on the left of the centre; for in whatever manner the storm advances, either by bodily transference or by successive transplanting, the motion of the wind must partake both of the direction of whirling and direction of progress, when seen by an observer not moving in either of these directions. In the case of bodily trans-

ferrence, the direction of the wind as shown by a vane will be the simple resultant of its whirling and progressive motions: in the case of successive transplanting, it will be the resultant of the earth's deflecting force and a curve of pursuit; a curve of pursuit being the path followed by a body moving towards a point that is continually changing its position. In either

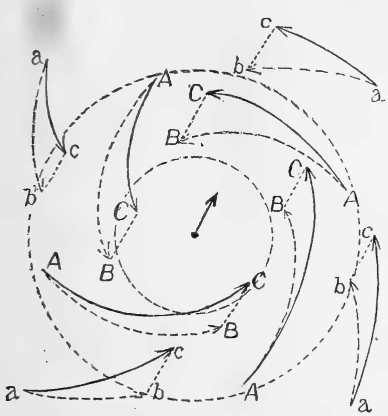


FIG. 18.

case, the effect may be sufficiently represented by fig. 18, in which the broken arrows show the motion of the wind with respect to the storm-centre, and the straight dotted lines measure the velocity of the storm's advance. The wind will seem to blow along the resultant of these two directions, as shown by the full arrows; and the resulting inclinations are

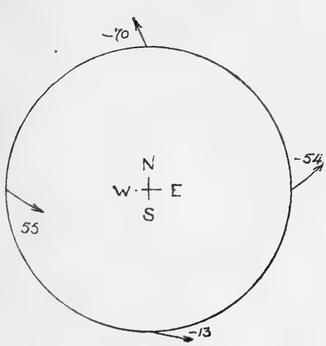


FIG. 19.

manifestly less in front than in the rear, and less on the right than on the left. With the variation of inclination, there will be an inverse change in the wind's velocity. It will blow faster on the right and rear or dangerous side of the storm, and slower on the left and front or manageable side. In the North Atlantic, where the storms often move rapidly, while a hurricane prevails south of the centre, very moderate winds may blow on the north; the difference between the two being about twice the storm's progressive motion. The change in inclination has been shown to occur in some of the West-Indian hurricanes, but it is not very pronounced in the land-storms of the temperate zone. Its best application is in storms on mountain summits; as on Mount Washington (fig. 19), and again in the case of the outflowing winds in the upper half of the storm, as shown by the motion of cirrus-clouds, and illustrated in fig. 20. Of course, in this case of outward motion, the less inclination is in the rear, and the greater in the front.

Third, in regard to land and sea storms. The inclination will be greater in the former than in the latter. On the sea, the centrifugal force of the earth's deflection will be most pronounced, and the winds will be more nearly circular than on land, where friction will tend

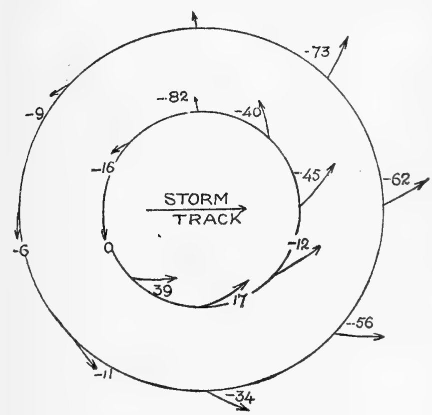


FIG. 20.

to destroy their original motion, and so allow them to run more directly into the storm-centre. This is fully borne out by observation, and is especially well shown in the contrasted cases of storms on the opposite sides of the northern Atlantic. Fig. 21 shows an average storm in the eastern United States, about ready to embark on the ocean; and in this the inclination of the winds is less on the sea than on the land side. This effect is doubtless produced in part by the preceding condition concerning the front and rear sides of the storm. But in examining a storm just about landing on the western shores of Europe, as shown in fig. 22, it is seen that here the front winds have the greater, not the lesser, inclination: hence position in regard to the centre cannot be the cause of the differing inclinations here. A better explanation is found in the fact that the eastern

side of the storm receives its winds from the land, and the western side from the sea; and, in accordance with this, the eastern side should have the greater, and the western side the lesser inclination, as is the case. The fact that European storms have a less velocity of progression than those in this country would still further allow the land and sea conditions to control the inclination in the former region.

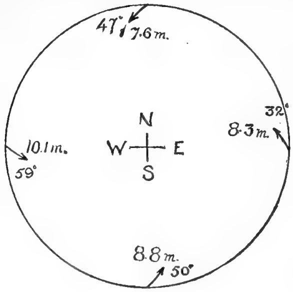


FIG. 21.

Fourth, it is manifest from all the preceding cases that the outermost winds of a storm are nearly radial, and that their direction becomes more circular as they advance. This results directly from the faster motion and less radius, consequently the greater centrifugal force near the centre, and requires no special illustration. It need only be noted, in recalling the first or latitude condition, that, at large distances from the centre, equatorial storms are generally more radial than those of the temperate zones; but, at small distances from the centre, this rule may have to be reversed. This is quite in accordance with the greater size but less intensity of the storms in the temperate zone.

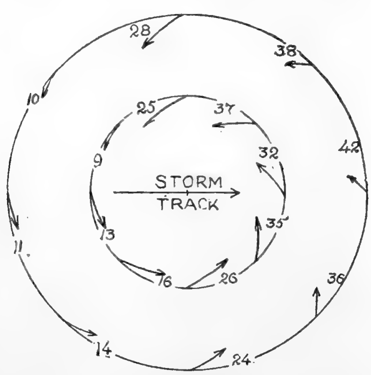


FIG. 22.

Fifth, in regard to altitude. The absence of strong friction will allow the upper winds to whirl in even more circular paths than they do at sea. Indeed, at a moderate altitude, say 7,000 feet, the winds are probably perfectly circular in the core of the storm; and at a little greater height they assume an outward inclination as they change to the outward spiral of the upper overflow. It is common, therefore, to note that the surface-winds of a storm are not parallel to the motion of the clouds. As the latter are more fully in control of the earth's deflecting force, they will always tend to the right of the former; and, in the extreme contrast of surface-indraught and uppermost outflow, the cirrus-clouds may drift slowly (in appearance) 90° or 120° to the right of the surface-winds. It is therefore usually to storm-disturbances of the general atmospheric circulation that the irregular drifting of different cloud-layers is to be ascribed. And now, after this long digression, we may return to the rescue of the vessel in the West-Indian hurricane.

(To be continued.)

THE BUSINESS OF THE NATURALIST.[1]

THE Society of naturalists of the eastern United States is an association in which all preliminaries should be brief, and ceremonious speeches out of place. Our first official meeting at Springfield was, however, almost wholly occupied with the technicalities of organization, and we necessarily gave but little time to other matters. The attendance at that meeting, on account of the natural aversion of scientific men to details of such an uninteresting nature, was small, compared with the numbers now present; and our list of members is also more than double what it was then. Under these circumstances a few preliminary words of explanation will not be wholly without usefulness. Our correspondence with scientific men also shows that the novelty of the organization and objects of this society requires some explanation in a comprehensive and condensed form from some one person.

So far as I am aware, this is the first attempt to form an association for the transaction of what may be called, without derogation to the dignity of our future labors, the business of naturalists.

Heretofore scientific associations have been founded and conducted upon the idea that the technical interests of science were necessarily inseparable from the results of scientific work, and should be considered by the same body which also attends to the presentation, discussion, and publication of the records of discovery and research. It has seemed to me for at least seven years past, that, on the contrary, a division of labor was necessary, and ought to be brought about. The technicalities of science have increased to an enormous extent within the last decade; and some effectual means of mutual culture and

[1] Address delivered in New York before the Society of naturalists of the eastern United States, Dec. 28, by the president, Professor Alpheus Hyatt of Cambridge.

co-operation should be found which can be of great benefit, not only to those whose opportunities have been small, but also not less to those who are capable of contributing most in such a scheme for the general good of science-workers. The contact of fellow-workers not only stimulates the intellect to its best efforts in the presence of appreciative hearers, but enables the mind to broaden its outlook, and avoid the effects of the cloister-like seclusion in abstraction, which has had such fascination for the students of all ages, and which has also had such serious effects upon the usefulness of individual life. The misconceptions and difficulties which science has to contend with have also become of greater importance; and one has only to mention the word 'vivisection' to justify this remark, and at the same time indicate a field for practical effort on the part of this society, which should bear good fruit in the immediate future. In fact, whichever way we turn, whether to the purely practical details of making sections, or other preparations in any branch of natural science, or to the broader questions of a technical nature which interest the public at large, we find in every direction paths of usefulness opening, which must lead to beneficial results for the future of science and science-workers, if properly and judiciously handled.

They seem to us to embody questions which are vital to the unimpeded progress of science. We can, it is true, get along without any efforts to ameliorate the present condition of affairs; but will this be the most desirable course for the interests of science and for our own future satisfaction? Will the amount of time we may gain for investigation by remaining at home, and standing aloof from disturbing causes, repay us for the inevitable loss of influence, and the possible loss of future facilities for the prosecution of work? In some classes of work such losses are sure to be visited upon us, or our immediate successors, through the growth of ignorant prejudices we have taken no trouble to correct or prevent.

An able writer in *Science* of Oct. 26, on the subject of vivisection, points out the necessity of taking some immediate steps for the information of the public upon this question, and, it seems to us, uses very able arguments to support the conclusion, which is, that "the only danger lies in the ignorance of the great majority of ordinarily well-informed people regarding such subjects." This writer, in conclusion, remarks with great force, "*Secrecy*, not publicity, is what American physiology has to fear."

The society may disagree with me, and perhaps consider it unnecessary to take any active steps in this direction; but the unavoidable effects of the general discussion of such a question will be very reassuring to the men who will have to bear the brunt of the coming struggle; and every one who takes part in it will find that his opinions and future course may be more or less influenced, and perhaps even determined, by what he may hear.

Those most deeply interested in the American association will surely be willing to grant that such questions can be more effectively handled in a society composed of purely professional men, whose undivided attention can be given to them, whose interest is of the deepest nature, and who can be depended upon to give sufficient time and work when appointed on committees.

Another question which seems to me of absorbing general interest relates to a matter about which great differences of opinion may exist, even among scientific men themselves; and in this I speak purely as an advocate of one side. What can we do to call the attention of the institutions of learning to the fact that their duties to science and the future of investigation demand a change of policy? Throughout the country, and even in the higher institutions, false views are prevalent with regard to the qualifications necessary for teaching science. We find science-teaching placed on the same basis as mathematics and the languages, in which books are the necessary media for the communication of ideas. It is commonly supposed that a man can learn his lesson, and repeat it to scholars, and that one may be a good teacher of a science of observation without being himself an observer. In some places even, a tendency towards investigation is considered a disqualification, since it withdraws the mind from giving full attention to the practical duties of the classroom. In such places education is measured by the quantity, and rule of thumb, by the amount of supposed knowledge gained, without relation to how it is gained, or what habits of mind are cultivated in the operation. Undoubtedly, the teacher in such places may need and acquire a certain amount of dexterity and success as a mental taxidermist; but that he will ever intentionally train a single student to do original work is beyond belief.

The slight amount of respect and consideration shown to the claims of the investigator are in part due to this evil, and in part to a custom which is excessively hard to deal with. We refer to the habit, very prevalent in this country, of sending children to the same colleges at which the parents themselves have been graduated. This habit shows some signs of breaking up, and the technical schools are doing fine work in this direction; still, the American mind is conservative in respect to education, and tends to keep the hereditary colleges full, irrespective of their intrinsic worth. If these institutions should have to rely solely upon their educational attractions, we should find that the individuality of instructors, their reputation for sound learning and original thought, and their capacity to do the highest kind of teaching, would eventually command the same respect, and perhaps the same emoluments, as in Germany.

Can we, as a body, arrive at any general agreement of what should be done with regard to such vital questions? or can we even do any thing towards the formation of an opinion of what it would be desirable to do? This last result will seem tame to many energetic minds; but the speaker is old enough to have seen the mighty effects of active and determined agitation upon what is familiarly known as public sentiment. Sooner or later — and generally much sooner than any but the most sanguine agitator can anticipate — the times become ripened, and the last

steps of the process of change to the new order of things follow in rapid succession. An event may be long in preparation, but its consummation takes place with a rapidity which must be experienced to be fully appreciated.

Another question of the greatest and at present time-absorbing interest is, what can be done to force the schools to properly prepare students for the colleges and universities? We use the word 'force,' rather than 'induce,' because all arguments except those which can be supported by the pressure of the entrance examinations fail to awaken these schools to the needs of science-teachers in these higher institutions. The following remarks appeared in *Science* of May 18, 1883, and can be used appropriately in this connection: —

"In the brief, informal discussions [which took place at the Springfield meeting], the opinion was very generally expressed, that one of the most important questions with which we have to deal, and one which needs immediate attention, is the preparation necessary for the study of natural science in colleges. The great difficulty in making a success of college instruction in the sciences lies in the fact that not one young man in twenty knows either how to observe, or how to think about facts of observation. His education in that line is very deficient, or else entirely wanting; he is utterly helpless without his books, and seems quite unable to see or to correlate facts for himself. No other branch of the curriculum is so inefficiently treated by the preparatory schools and academies. It is the reverse of right that the college professor, with a class of from forty to eighty men, should have to make the vain attempt to teach the lowest step in the observational sciences. Methods which can alone guarantee success in imparting to the eye and the mind the rudiments of science cannot be employed under such conditions. Moreover, it is a matter for the deepest regret, that young men who are soon to be in places in the world where they have no books, and where the keenest exercise of the powers of observation, and the judgment of facts, are demanded, should in so many cases have no opportunity, or next to none, either in school or college, for the acquisition of a training upon which the success of their life-work, in the larger number of professions and occupations, is dependent.

"It is to be hoped that one needs only to mention such objects as these, to bespeak for this new association the sympathy and support of all naturalists, and earnest workers in science."

In the above remarks expression is given to opinions some of which, we know, will meet with general approbation, and others will very properly be regarded as merely personal views. We shall, however, have attained the object for which this address was written, if we have made it evident that this society can, if it be so disposed, take up questions of the highest importance to the public service of science, and help towards their solution by its deliberations. We believe it can do this wherever it can unite the majority of scientific men in opinion and in effort. The power which can be wielded by such an organization is in exact proportion, not to its numbers, but to its earnestness, determination, and especially its fearless support of what is just and right.

After referring further to the work of the society, as outlined in the article already referred to, Professor Hyatt proceeded: —

Enough papers to occupy nearly the whole time which can be devoted to them will be announced by the secretary. Though these and kindred subjects will be our most important objects, it was due to the society to show that its scope was not necessarily wholly confined to such details; and this we have endeavored to accomplish in the first part of the preceding remarks.

In conclusion, we beg leave to report that the executive committee has had great responsibilities thrust upon it since the first meeting. These they have endeavored to meet to the best of their ability; and we believe that the present attendance, and the many honorable names on our list, will help to extenuate the errors inseparable from haste and overwork.

In place of Professor Clarke, whose absence in Europe we regret, the executive committee appointed Dr. C. S. Minot, and he has faithfully and acceptably performed the duty of secretary *pro tem.*

THE NEW MORPHOLOGICAL ELEMENT OF THE BLOOD.

WITHIN recent years it has been established beyond doubt by the labors of Hayem, Bizzozero, and others, that there exists in the blood of mammals, and apparently of other vertebrates, a third type of corpuscle, differing morphologically from both the red and the white corpuscle, and possessing certain distinctive properties of the greatest importance in coagulation. These elements were called hematoblasts by Hayem upon the supposition that they are eventually transformed into red corpuscles. As this view is by no means established, it will be better to speak of them as blood-plates, the name given to them by Bizzozero. These blood-plates must not be confounded with the 'invisible corpuscles' of Norris. The latter, according to the testimony of most observers, are simply ordinary red corpuscles, from which the haemoglobin has been removed by the method of preparation. As might be supposed, the presence of these bodies was more or less clearly noticed by some of the many observers who for years past have made the blood a subject of investigation. That they escaped detection in the great majority of cases, is owing, doubtless, to the very rapid alterations which they undergo after the blood is shed, unless especial measures are taken to preserve them.

To Hayem belongs the credit of their real discovery. His investigation of their form, and, to a certain extent, of their properties, was so thorough, and his method of demonstrating their presence so simple, that the attention of other observers was forced to the subject; and his results were soon confirmed, with the exception of certain details of structure which are still open to investigation. On account of the quickness with which they are destroyed after the blood has escaped from the vessels, it is necessary to make use of certain preservative liquids which have the power of fixing these corpuscles in their normal shape. The solution recommended by Hayem is composed, of water 200 parts, sodium chloride 1 part, sodium sulphate 5 parts, and mercuric chloride .50 parts. Bizzozero recommends a .75% solution of sodium chloride, to which some methyl aniline violet has been added. Osmic-acid solution, 1%, may also be used. To obtain good specimens of the blood-

plates, the following method is suggested by Laker. A drop of preservative liquid is placed on the slide, and a drop of blood on the cover-slip, and the slip laid quickly on the slide, so that the two drops come in contact. As many as possible of the red corpuscles are then drained off by means of a piece of filter-paper applied to the slip on the side opposite to the drop of preservative liquid; or the two drops may be placed on the slide, and the cover-slip laid on from the side of the preservative liquid. The one precaution which it is necessary to observe is to lose as little time as possible in transferring the blood to the preservative liquid.

Obtained in this way, the blood-plates of the mammal are small, non-nucleated, discoid bodies from one-fourth to one-half the size of the red corpuscles. Hayem states that they are bi-concave, like the red corpuscles, and that many of them have a slight greenish or yellowish color due to the presence of haemoglobin. Bizzozero, on the other hand, maintains that they are perfectly colorless and not bi-concave. Mayet supports Hayem's statement with regard to the presence of haemoglobin in some, at least, of the blood-plates; while Laker thinks that the pale greenish hue possessed by them is owing to a reflection of light from the upper surface. The same tint may be observed in white corpuscles; and, furthermore, when the blood-plates are collected in masses, this color does not become more distinct. Laker confirms Hayem's statement that the plates are bi-concave, and says that he has often obtained from them the well-known optical phenomenon shown by the red corpuscles. The blood-plates occur in considerable numbers. According to Hayem, they are forty times more numerous than the white corpuscles, and twenty times less numerous than the red corpuscles. Staining-reagents have but little action upon them. Water causes most of them to disappear, though some individual plates may resist its action for a long time. Dilute solutions of acetic acid or caustic alkali quickly destroy them, while a 35 % solution of caustic potash is without any marked action. Laker states, that, in their general behavior towards reagents, they resemble most the nucleus of the white corpuscle. With regard to their origin, nothing is known. That they are not simply remnants of broken down white corpuscles is evident, in the first place, from the typical form they possess, and, in the second place, from the difference in chemical composition between the two, as shown by reagents. Bizzozero has proved conclusively that they are not pathological formations arising after the blood has been shed, since he has seen and studied them in the mesenteric blood-vessels of living animals.

Hayem believes that the blood-plates are finally transformed into red corpuscles. His reasons for this belief are as follows: 1. They possess a similar form; 2. They have a similar chemical composition, both containing haemoglobin; 3. The appearance of many intermediate forms between the typical blood-plate and the ordinary red corpuscle, especially in certain pathological conditions — after a severe hemorrhage, for instance. Under these conditions, Hayem states that the plates become more abundant, and gradually return to their normal proportion as the number of red corpuscles increases. In the main, these statements are confirmed by Mayet; but, as we have said, the similarity in form, and the presence of haemoglobin, are denied by others, especially Bizzozero; and neither Bizzozero nor Laker was able to detect any intermediate forms between the blood-plates and the red corpuscles. Perhaps the most interesting result that has come out of the study of these elements is the knowledge of the important part they take in the coagulation of blood. This property has been thoroughly investigated by Bizzozero. His conclusions may be briefly stated as follows. Liquids which have a tendency to prevent coagulation also preserve the blood-plates more or less completely from destruction. Experiments made upon blood kept within the living blood-vessel show that as long as the blood remains uncoagulated the blood-plates are unchanged, while the rapid coagulation of portions of the blood removed from the vessel is always preceded by a destruction of the plates and the formation from them of granular masses. When a drop of blood is whipped with small threads for about fifty seconds, the threads withdrawn, washed gently in .75 % sodium-chloride solution, and then examined under a microscope in the methylated soda solution, they are seen to be covered with a layer of plates, together with some white corpuscles. If the whipping is continued longer, the plates are converted into a granular mass, and covered with a layer of fibrine. If this process is reversed, and a slow stream of blood is allowed to pass over a thread watched under the microscope, the different stages of the process can be observed, — the deposition of the plates, their fusion into a granular mass, and the subsequent formation of fibrine. When one of these threads, to which the blood-plates and a few red and white corpuscles are adhering, is added to a liquid containing the two fibrine factors, but not fibrine ferment, coagulation takes place. That this coagulation is not owing to the thread or to the red corpuscles is easily demonstrated: it must result from the addition of either the white corpuscles or the blood-plates. When, however, bits of tissues rich in leucocytes — such as the spleen, lymph-glands, medulla of bone — are added to the above liquid, no coagulation at all, or else a very imperfect coagulation, follows. The inference, then, is, that the coagulation in the first case results from the addition of the blood-plates. In his latest communication, Bizzozero states, that if to a few drops of peptonized plasma, which coagulates very slowly, some water or carbon dioxide is added, and the preparation is examined under the microscope, the blood-plates will be seen collected into large heaps in which the individual blood-plates may still be recognized. In a few minutes the plates fuse together into a granular mass which becomes vacuolated, and at this moment coagulation begins. From the periphery of the granular heaps hundreds and thousands of fine processes radiate, and form a network which slowly spreads into the surrounding plasma.

Bizzozero attributes the origin of thrombi in blood-vessels to the destruction of these corpuscles. He has been able to watch the process of formation in the mesenteric vessels of living animals when a lesion of the walls of the vessels was produced in any way.

In the blood of animals with nucleated red corpuscles, Hayem has described a form of corpuscle which has properties analogous to those possessed by the blood-plates of mammals. These corpuscles may be preserved for study by the use of the liquids mentioned above. They are colorless, nucleated, slightly flattened bodies, bearing a general resemblance in shape to the red corpuscles, though usually more elongated at one or both of the poles. They vary greatly in size, but as a rule are somewhat larger than the white corpuscles. They are distinguished from the white corpuscles mainly by a difference in form and by the changes which they undergo after the blood has been shed. The white corpuscles are always more or less spherical, while the plates are flattened disks. After the blood has been shed, they become exceedingly viscous, and form granular masses from which fibrous processes radiate. Their functional value in coagulation appears to be the same as that of the blood-plates in mammals with non-nucleated red corpuscles.

William H. Howell.

THE COMSTOCK LODE.

Geology of the Comstock lode and the Washoe district. By George F. Becker. (Monographs U.S. geol. surv., iii., with an atlas.) Washington, 1882. 422 p. 4°.

The appearance of the second of the new series of monographs published by the U. S. geological survey will be greeted with pleasure by the scientific world, not only on account of the amount of new information it contains regarding the geological and physical character of one of the most important ore-deposits on the globe, but also as an index of the increasing interest which is being taken in this country in a very important but comparatively new branch of geological research. Becker's report contains, with perhaps one exception, the most considerable contribution yet made by an American to microscopical petrography, and deserves for this reason, aside from its other merits, high commendation.

Referring, for a historical, economic, and technical treatment of the Comstock lode, to the works now in preparation by Messrs. Lord and Eckart, the author devotes himself to a purely scientific investigation of this interesting region. A *résumé* of the results reached by von Richthofen, Zirkel, King, and Church, is given, which is followed by a detailed description of the rocks in connection with which the ore-deposits occur. This work is carefully done, and, notwithstanding a very apparent lack of acquaintance with the literature and many important methods of modern petrography, is a valuable contribution to the subject. For instance: the actual presence of the suspected sodalite in the granite might easily have been placed beyond a doubt by a simple microchemical test. Again: the measurement of extinction-angles would have been much more satisfactory had they been made on cleavage pieces from their isolated powder instead of in the sections; while Boricky's test would certainly have yielded as good results as Szabo's.

The variety of rocks in the area studied is very great, comprising, in order of their ages, granite, metamorphics, granular diorite, porphyritic diorite, metamorphic diorite, quartz-porphyry, earlier diabase, later diabase, earlier hornblende andesite, augite andesite, later hornblende andesite, and basalt. None of these exhibit in their occurrence or structure any thing very striking or abnormal, if we except the sodalite in the granite, whose presence is, however, left very doubtful. Of especial interest are the decomposition processes, which have altered the rocks in the area between the Comstock and Occidental lodes almost past recognition. These are thought to be due to solfataric action, which was not earlier than the eruption of the later hornblende andesite; and they have received a good share of the author's attention. All the rocks of this area are equally decomposed; and, in the case of all, the same minerals have undergone the same alteration. Hornblende, augite, and mica change into chlorite, and this in turn generally to epidote, though sometimes to a mixture of quartz, calcite, and limonite. The felspar becomes filled with secondary fluid inclusions, and finally forms a mass of calcite, quartz, and a substance of unknown character, which, according to the author, is certainly not kaoline.

By far the most interesting results of the author's studies, from a petrographical standpoint, are those arrived at in reference to the origin and nature of that much-discussed rock-type, propylite. As is well known, this name was given by von Richthofen to certain early tertiary, andesitic rocks of Hungary, possessing a fibrous green hornblendic constituent and a granitic habit. Both von Richthofen and Zirkel regarded the Washoe district as a locality where this type was especially well developed; and the present author entered upon his work fully convinced of the correctness of their views. All the more interesting, then, is the fact that a careful and elaborate study of these

very rocks forced him to the opinion that propylite has no right whatever to be regarded as an independent rock-type, but is always an alteration product of diabase, diorite, or andesite, by the change of the bisilicates to uralite or chlorite.

In chapter iv. the author discusses theoretically the structural results of faulting. He regards the schistose structure, so often observed in the andesite, as the result of faulting under intense lateral pressure, and shows that such sheets would naturally tend to arrange themselves in a logarithmic curve, as seems to be the case at the Comstock.

The chapter on chemistry is not very satisfactory. But few new rock analyses are offered, and none are ably discussed in connection with the microscopic diagnosis. The finding of very small quantities of ore in the accompanying rocks, especially the diabase, would seem to suggest just the reverse course of reasoning from that adopted; and certainly none of the facts presented appear to warrant the supplanting of von Richthofen's theory, that the ores came from great depths, by one ascribing their deposit to segregation produced by ordinary solvents (hydrogen sulphide and carbon dioxide) from the rocks at the side of the lode.

The discussion of the heat-phenomena of the lode receives especial attention in chapter vii. The rapid increase of temperature is well known to be one of the great hinderances in working the mines, being nearly double the average observed elsewhere. This has been accounted for by some by chemical action: as, for instance, the oxidation of pyrite, or the kaolinization of felspar. The author concludes, however, in light of the careful experiments conducted by Dr. Barus in reference to the latter theory, that such an explanation is untenable; and that the source of the heat must be sought in former, and not entirely extinct, volcanic activity.

The observations of Dr. Barus, bearing on the electrical activity of ore-bodies, are recorded in chapter x. They relate as well to the deposits at Eureka as to those in the Comstock, and, while not directly productive of results of practical importance to the prospector or miner, possess a very considerable scientific interest.

The execution of the plates and maps is up to the usual high standard of the survey publications. The chromolithographic representations of rock-sections in polarized light are particularly successful, and, as far as my experience reaches, are the best of the kind yet produced anywhere.

MARTIN'S ELEMENTARY PHYSIOLOGY.

The human body: an elementary text-book of anatomy, physiology, and hygiene. By H. NEWELL MARTIN. New York, *Holt*, 1883. 11+355 p., 4 pl., illustr. 16°.

THIS volume forms the second volume in the 'American scientific series, Briefer course,' published by the Messrs. Holt. It is an abridgment of a larger work by the same author, and is intended for use in schools and academies. The demand for such a book, and the difficulty of preparing one, are well known to any one who has sought in vain, among the numerous text-books now in the market, for one really scientific, and suited to the age and needs of his pupils. It is a book of about three hundred and fifty pages, but how it could well have been made smaller we do not see. The language is simple, the style clear, and the book, at the same time, easily comprehensible and thoroughly scientific. It is elementary without being superficial. The essential facts are pointed out to the pupil without taxing his memory with a mass of unimportant details, or vexing him with conflicting theories on unsettled questions. At the end of each chapter these are condensed, and their connection shown in a brief summary, which aids the memory, and excites the interest of the pupil. From the physiological facts are deduced the most important laws of hygiene, while the student gains glimpses of wider fields of anatomy and zoölogy in the footnotes.

A new and most important characteristic of the work is the series of directions to teachers for demonstrating on frogs and rats the main outlines of anatomy, and for physiological experiments accompanying each chapter. These are all clearly explained, and easy, yet it is to be feared that they will be neglected by three-fourths of the teachers using the book. Their importance might well and justly have been far more strongly urged in the preface. We hear every year less of the objections to such dissections. The great difficulty is, that most of the teachers in our schools and academies have been taught physiology in the old way; and many of them have never even seen the inside of a frog. They greatly over-estimate the difficulties of such dissections and experiments, and do not appreciate that the sight of the real organ or process is worth more to the pupil than an hour's study of text-books or charts. If the teacher will once try fairly the experiment of following these directions, he will be surprised at the small amount of extra work caused, and at the enthusiasm

which they call forth in his class. The figures of the book are large and clear: in one or two of the plates so much has been attempted that they appear, at first sight, confused; but this is a slight blemish in a book worthy, in other respects, of all commendation. The book is well fitted, in the language of the author in his preface, to "prepare the student for the work of subsequent daily life by training the observing and reasoning faculties."

PACKARD'S BRIEFER ZOÖLOGY.

Zoölogy. By A. S. PACKARD, jun. New York, *Holt*, 1883. 5+334 p., illustr. 16°.

THE Zoölogy of the same series as the preceding is also an abridgment of and introductory to the larger text-book by the same author. Of the 315 pages of the text, only 130 are devoted to invertebrates: of the 180 pages devoted to vertebrates, many are occupied by large and very ornamental but hardly useful pictures. Of about 300 cuts, 90 are devoted to birds and mammals, and 40 to fish: of these a few are anatomical, the rest illustrations. The removal of many of these cuts would leave room for more print, without affecting the attractiveness of the book. The book is intended for young pupils, and yields to the common prejudice that birds and mammals are most interesting to this class. Yet precisely these animals come least within their reach, and their study of birds especially involves far more memorizing than observation on the part of most young pupils. These same pupils, in one afternoon excursion, could collect scores of insects, in which Professor Packard, as his other books show, could easily interest them. But to insects proper only 16 pages are devoted. Here a few pages of tables for determining the families, at least with one or two of the most common and familiar species as examples under each, would encourage the young student to new search and observation.

Of most of the lower types and classes the young student sees generally only one or two specimens, if any. Here clear, sharp, and exact definitions are needed to enable him to distinguish between essential and non-essential characters. These we miss; and here, as under certain types in the larger text-book, the student becomes bewildered in the attempt to burden his memory with a mass of, to him, equally important data. This is especially noticeable in the treatment of the difficult type of the Coelenterata, but more or less marked elsewhere. The points of affinity and difference between the succeeding types and the structural characteristics which form the basis of classification in the subdivision of those types are not clearly or sharply stated. There are no grand outlines to direct the student's attention. In a text-book intended exclusively for use in the laboratory, it is perhaps admissible that typical and specific characteristics should appear side by side, and with equal emphasis; in a text-book designed largely for use in the classroom as well, it is a great defect. These outlines are little, if any, clearer in the abridgment than in the larger book. The anatomical cuts are generally good, but they are most of them small, much smaller than those of the elk or moose; and in some of them so much has been attempted that the organs are sometimes difficult to trace. Larger and more schematic drawings would have been more useful. Barring certain of these defects, Professor Packard's larger work is the best text-book which we have for use in our higher schools and colleges, but it certainly has not been improved by abridgment.

MARIE'S HISTORY OF THE SCIENCES.

Histoire des sciences mathématiques et physiques. Par M. MAXIMILIEN MARIE. Tome I. De Thalès à Diophante. Paris, *Gauthier-Villars*, 1883. 286 p. 8°.

THIS volume is devoted to the mathematics of the Greeks, and covers nearly a thousand years (640 B.C. to 325 A.D.).

The author divides this time into three periods, roughly distinguished by the nature of the work done in geometry; the first period (640 B.C. to 310 B.C.) being that in which no attempt was made to apply arithmetic to geometry, but exclusive attention was given to dealing with and comparing concrete magnitudes without reference to their numerical measures. During the second period (310 B.C. to 150 B.C.), numerical measures of complex magnitudes began to be investigated, — for example, Archimedes obtained a first approximation for the ratio of the circumference of the circle to its diameter; but the numerical work was merely incidental, and was usually suggested by some problem connected with astronomy: while, in the third period (150 B.C. to 325 A.D.), reasoning on concrete magnitudes began to be largely replaced by reasoning on their measures, and geometry developed mainly in the direction of trigonometry.

At the beginning of the history of each of these periods is an introductory chapter con-

taining a brief *résumé* of the principal characteristics of the period, together with a short account of the progress made during the period in each of the branches of the mathematical science of the time, — geometry, arithmetic, physics, and astronomy. This is followed by the biographies of the mathematicians and physicists of the period and an analysis of their work.

The three introductory chapters, taken together, form a short and interesting history of Greek mathematics; while the biographies are sufficiently full, and the analyses are remarkably clear and concise.

SECONDARY BATTERIES.

The chemistry of the secondary batteries of Planté and Faure. By J. H. GLADSTONE and ALFRED TRIBE. London, *Macmillan & Co.*, 1883. (Nature series.) 11+59 p. 16°.

THE valuable papers of Gladstone and Tribe, originally printed in *Nature*, have been published in a collected form in the present volume, which contains much information as to the chemical actions going on in the Planté and Faure batteries. In successive chapters the authors consider the subjects of local action, the chemical changes occurring in the charge and discharge of the cell, the function of the sulphate of lead formed, and some minor topics. The chapter devoted to the function of the sulphate of lead, which the authors have shown to be formed in the normal action of the battery, is especially interesting. In the formation of a Faure cell, sulphate of lead, originally produced by local action, is oxidated to a peroxide on one plate, and reduced to spongy metallic lead on the other; and, when the cell is discharged, lead sulphate is finally produced on both plates. On recharging the battery, the authors consider that the lead sulphate is again oxidated on one plate, and reduced on the other, as when the cell was originally formed, — a point which is a very practical one, as the lead sulphate, if not oxidated, will soon prove fatal to the usefulness of the cell. This view, announced in the original papers, is substantiated by a number of recent experiments, notwithstanding the doubts that have been thrown upon it; so that, in charging and recharging, the plate of the cell is not corroded. It is also shown that the fact noticed by Planté, that elevation of temperature facilitates the formation of the cell, is explained by the more rapid formation of lead sulphate under these conditions.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Vassar brothers' institute, Poughkeepsie.

Dec. 5. — Professor W. B. Dwight gave the results of a recent re-examination by himself of Van Duzer's iron-mine, Cornwall station, Orange county, N.Y. Here a low ridge presents a red rock of sandstone and conglomerate, running into red shales to the south, in contact conformably with a highly fossiliferous limestone in nearly vertical layers. No other combination of the kind is apparent in this region, and there was much speculation among early geologists as to the horizon. W. B. Rogers called the red rock the triassico-jurassic sandstone; Dr. W. Horton considered it the Medina group, and assigned the limestone some place lower; Prof. Mather, with some doubt, concurred with Horton, and further assigned the limestone to the Catskill shaly limestone. Prof. Dwight, after a careful study of the locality, is satisfied that the red rocks are of the Medina epoch, and the limestones lower Helderberg; but by the fossils he identifies, in addition to the Catskill shaly limestone, the tentaculite limestone and the lower pentamerous groups. He finds no foundation for the statements of Horton, indorsed by Mather, that the iron ore occurs in layers between the layers of limestone. On the other hand, it is a bed of limonite formed at the base of the ridge superficially, as in other iron-mines of the region, by the decomposition of the red ferruginous shales at the junction with the limestone.

Five hundred and sixty-two specimens, representing various departments of natural history and archeology, were reported to the museum by the secretary.

Franklin institute, Philadelphia.

December 19. — A special committee, appointed to consider the propriety of recommending the councils of the city of Philadelphia to pass an ordinance requiring steam-engineers to pass an examination and to be provided with a license, as evidence of their competency, made majority and minority reports; the first taking the view that such action on the part of the society would be inexpedient, and the latter recommending such action. The reports were freely discussed, *pro* and *con;* and the subject was postponed for final action until the stated meeting in January.

Mr. G. Morgan Eldridge then read a paper on 'The British patent designs and trade-marks act of 1883 as affecting American inventors,' explaining the provisions of the new law to go into operation on the 1st

of January, 1884, and especially clearing up many points wherein the technical journals, which had favorably reviewed its provisions, had erred.

Prof. E. J. Houston introduced Mr. Patrick B. Delaney of New York, who thereupon described in detail his lately invented system of synchronous-multiplex telegraphy, illustrating the same with the aid of detail-drawings and lantern-slides of essential portions of his apparatus. Mr. Delaney's system, as thus far perfected, permits of the sending of seventy-two separate and distinct messages over a single wire simultaneously.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Geological field-work. — Mr. J. S. Diller, in his reconnaissance of the Cascade Range, passed through the Dalles, at the north end of the range, and followed it southward into California. The following is an abstract of the preliminary report made by him to Capt. C. E. Dutton, who has charge of the investigation of the volcanic rocks of that region. Andesites and basalts are found on the west side; and at Oregon City the lavas have a thickness of three hundred feet. The massive rocks stretch far southward towards Salem; and on them rest extensive alluvial deposits which form fertile plains in the valley of the Willamette, French's Prairie being one of them. Between Salem and Albany the eruptive rocks also occur; but at Jefferson, a short distance north of Albany, the miocene sandstone occurs, and is extensively used in the neighborhood for building-purposes. From Albany to Eugene City, both eruptive rocks and the miocene sandstones occur, the latter being well exposed at Springfield and before reaching the Calapooia Mountains. Thirty-five miles south of Eugene City the miocene sandstone is frequently penetrated by basaltic and other eruptive rocks. Near Cottage Grove the sandstone resembles somewhat a tufa, but contains coal, like the miocene north-east of Lebanon. Coal with a thickness of five feet is said to occur at the great bend of Pit River, but was not seen by Mr. Diller, as he did not visit the locality. The Calapooia Mountains are made up mainly of recent volcanic rocks, especially on the north side. Fragmental rocks are found on the south; but whether they are paleozoic, or not, remains in doubt. These beds extend to near Oakland, where well-marked tertiary appears. South of Rosebury is a belt two miles in width, of olivine enstatite rocks, altered, for the most part, into serpentine. It is bounded on the south by a highly tilted conglomerate, which resembles the millstone grit of the Alleghanies. No fossils were found in it, but on petrographical grounds it was referred to the cretaceous, which Mr. Diller says has not been recognized north of Rogue River valley, from which it is separated by a belt of crystalline stratified rocks, — the eastward continuation of the Rogue River Mountains. South of Myrtle Creek, schistose rocks occupy a belt along the southern branch of Umqua River to Cañonville, where crystalline schistose rocks form the prominent mountain ridge through which the gorge of Cañon Creek is cut. These rocks are penetrated by a granite which has probably been land-surface for a long time. This granite outcrops frequently in southern Oregon and northern California, especially in the Siskiyou Mountains, which are principally made up of it: it also forms Trinity Mountain and Castle Rock.

The crystalline rocks representing the eastern prolongation of the Rogue River Mountains are limited on the south by the supposed cretaceous rocks of Rogue River valley. Mr. Diller thinks that both cretaceous and tertiary rocks are embraced in the section seen on the north-east side of Stewart's Creek (a tributary of Rogue River extending eastward from Jacksonville). These rocks extend into California, where they are covered by the great flow of recent eruptive rocks in the plain north of Mount Shasta.

Little Shasta valley, especially between Shasta post-office and Mount Shasta, is an extensive plain covered by a flow of basic lava like that on the great plain east of the Cascade Range in central Oregon. Mount Shasta rises above a similar plain.

At the Haystacks, a short distance north of the base of Shasta, granite occurs. Between Mount Shasta and Lassens Peak, Cambrian, mesozoic, and tertiary occur. Around the eastern base of Shasta to Burney valley, and westward over the mountain crest to Buzzard Roost, little else is seen than basic volcanic rocks. Four miles west of Furnaceville the road leaves Cow Creek, and ascends to the 'plain,' which is covered with angular bowlders and thin soil underlaid by coarse conglomerate. From Buzzard's Roost a cañon along Cow Creek is cut in carboniferous limestone and other altered sedimentary rocks.

At Furnaceville, in the metamorphic rocks found west of the limestone, mining operations have been carried on; but at present the openings are deserted. Farther west, cretaceous (?) strata come in, dipping towards the Sacramento; and above them, tertiary rocks full of fossils. The latter extend to the alluvial plain of the Sacramento.

The Cascade Range, constituted almost wholly of basic lavas, is a low, broad arch, not less than seventy-five miles in diameter, rising from 3,300 feet at Summit Prairie, near Mount Hood, to 5,600 feet at Crater Lake. About the head of Deschutes River the general plain, which more or less gradually merges into the slope of the mountains, has a height of 4,700 feet. Throughout Oregon this plain lies about a thousand feet below the general crest of the range; and both are formed of lava sheets arising from fissure eruptions. There are numerous topographi-

cal elements on the broad arch produced by local extrusions, or subsequent erosion; lava having been poured from many craters that rise from eight hundred to eight thousand feet above the arch, forming an irregular series of ridges having here and there a radial arrangement. Some are on a line, as if from a common fissure; but, for the most part, they are irregular in distribution. The great peaks of the range are all remnants of old craters. The larger ones form the most prominent peaks of the system, and, although post-miocene in age, are older than many of the smaller ones, which are mainly cinder-cones, which retain their crater-form more or less perfectly. As a rule, also, the latter are basaltic, while the chief mass of the larger ones is andesitic.

While Pit River, and perhaps some of its prominent tributaries, as well as the Umqua and Rogue rivers, are examples of antecedent drainage, it is probable that the Klamath and Columbia rivers, with their tributaries, are, in part at least, consequent. However, the trip was too hasty to make completely trustworthy observations on this point.

—During July, August, and September, Dr. F. V. Hayden, with Dr. A. C. Peale as an assistant, made a geological reconnaissance along the line of the Northern Pacific railroad from Bismarck, Dakota, to Helena, Montana. Geological sections were made at various points, especially with reference to the line between the Fox Hills cretaceous and the Laramie group. Collections of fossil plants and shells were made at Sims, Gladstone, and Little Missouri, in Dakota, and at Glendive, Miles City, Billings, the Bull Mountains, Stillwater, Livingston, Bozeman, and other places, in Montana. The various coal-mines along the line of the road were visited and examined, as were also the borings for artesian wells at Bismarck, Dakota, and at Billings, Montana.

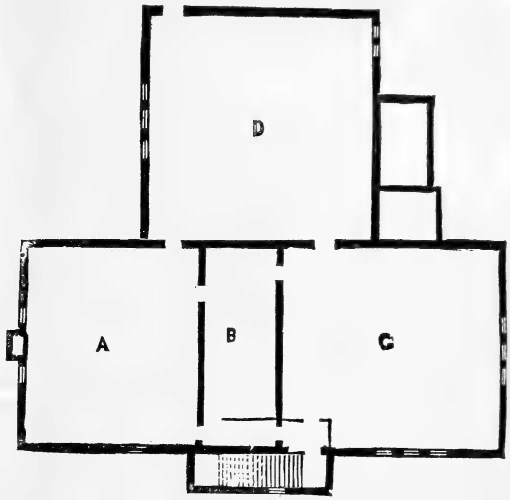
STATE INSTITUTIONS.

University of Kansas, Lawrence.

The new chemical laboratory.—The regents of the university have wisely provided for the increased growth and importance of the chemical department by the construction of a building for laboratory purposes. It is built of native limestone, with dressed stone and brick trimmings, and, as may be seen from the engraving, is in the form of a T.

The part extending east and west is 80 by 35 feet, and the L north of this is 40 feet square. The main laboratory and lecture-room are finished to the rafters, and all the rooms on the main floor are provided with additional light and abundant ventilation by skylights. The ground-floor rooms are 12 feet in the clear, and well lighted. These are occupied by an assay-room with crucible and muffle furnaces and complete apparatus for the fire assay of ores, and also by laboratories for blow-pipe work.

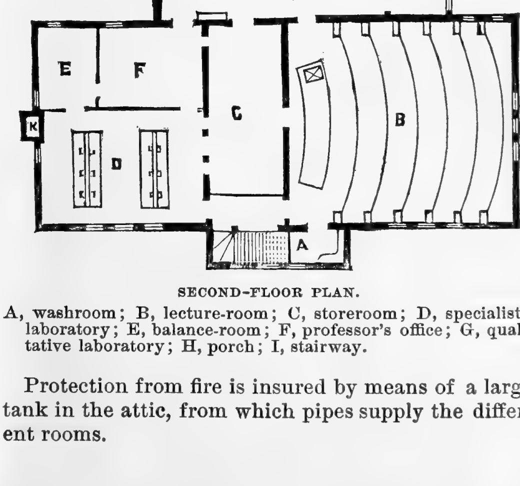
The east wing of the main floor, which is 14 feet to the eaves, is occupied by a lecture-room, seated in amphitheatre style, and capable of accommodating from 80 to 100 students. In addition to the ventilating apparatus above mentioned, the plan includes flues in the wall, connected with hoods, and hoods in the centre of the main laboratory, which are ventilated by glazed pipes terminating above the roof.



GROUND-FLOOR PLAN.

A, fire assay room; B, storeroom; C, metallurgical and blow-pipe laboratory; D, wet assay room.

All the rooms are supplied with running water, and gas, and heated by steam. The laboratory intended for qualitative students has over 25,000 cubic feet of air-space, and is intended for 54 students, each to be supplied with cupboards, sets of reagent bottles, etc. The tables are to be furnished with slate tops, and, in the quantitative room, with filter-pumps.



SECOND-FLOOR PLAN.

A, washroom; B, lecture-room; C, storeroom; D, specialists' laboratory; E, balance-room; F, professor's office; G, qualitative laboratory; H, porch; I, stairway.

Protection from fire is insured by means of a large tank in the attic, from which pipes supply the different rooms.

The building was erected at a cost of $12,000; and this sum, wisely and economically expended, leaves the chemical department as amply provided with facilities for instruction as any institution west of the Mississippi. E. H. S. Bailey.

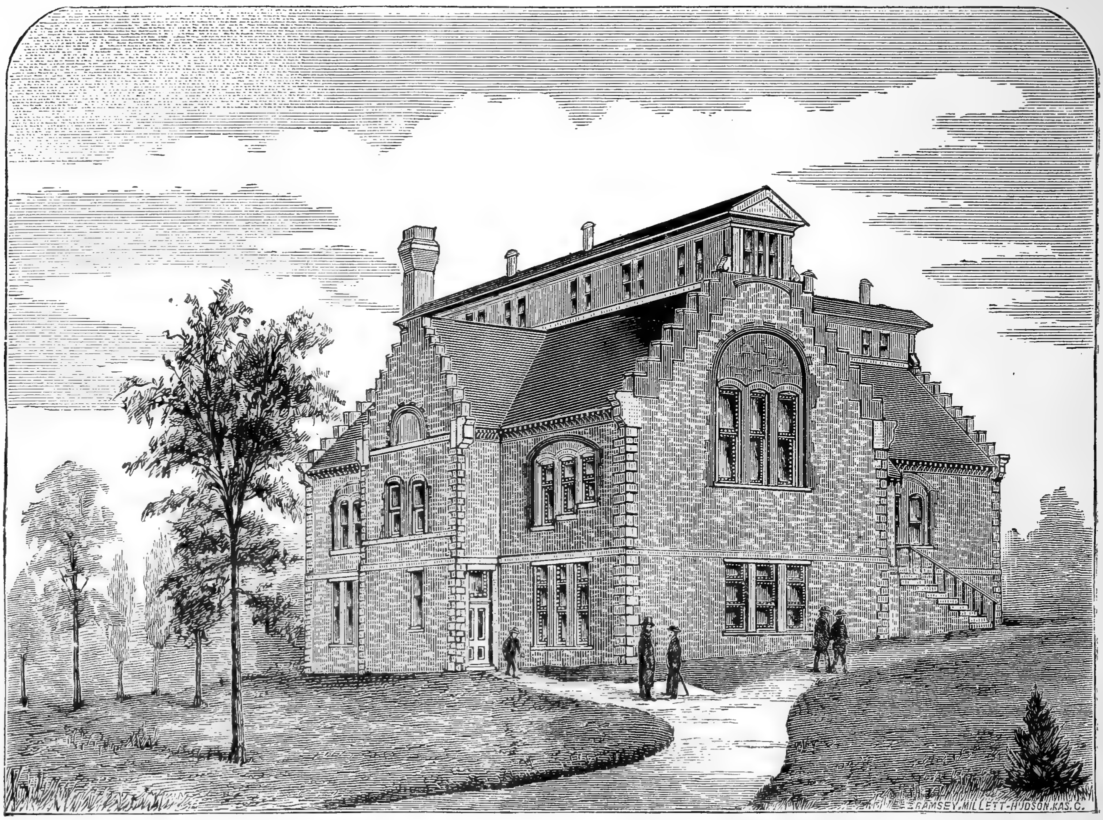
Lawrence, Kan.

NOTES AND NEWS.

Nature states that the Swedish frigate Vanadis has just started on a cruise round the world. King Oscar's second son participates in the cruise, as well as Dr. Hjalman Stolpe, who has been commissioned by the government to collect materials for the nucleus of a national ethnographical museum in Stockholm. The frigate, whose mission is chiefly scientific, will call at many places of interest, as, for instance, the Straits of Magellan, the Marquesas and Hawaiian Islands, the remarkable Malden Island, etc. A Swedish merchant, M. Fürstenberg of Gothenburg, has contributed six hundred pounds for the purchase of objects of scientific value.

— The Conseil municipal of Paris has granted a subsidy of 38,000 francs for the construction of a building in the Parc de Montsouris for the use and annual exhibitions of the Central society of apiculture and insectology. It is hoped to hold there the exhibition of 1885.

— M. Bourdalou having published in 1864, in his work 'Nivellement général de la France,' that the average level of the Mediterranean is by 0.72 metre lower than that of the Atlantic, this result was received with some distrust by geodesists. Gen. Tillo points out now, says *Nature*, that this conclusion is fully supported by the results of the most accurate levellings made in Germany, Austria, Switzerland, and Spain, which have been published this year. It appears from a careful comparison of the mareographs at Santander and Alicante by Gen. Ibanez, that the difference of levels at these two places reaches 0.66 metre, and the differences of level at Marseilles and Amsterdam appear to be 0.80 metre when compared through Alsace and Switzerland. The 'Comptes rendus de la commission permanente de l'association géodésique internationale' arrive at 0.757 metre from the comparison with the Prussian levellings; whilst the fifth volume of the 'Nivellements der trigonometrischen abtheilung der landesaufnahme' gives 0.809 *viâ* Alsace, and 0.832 *viâ*



NEW CHEMICAL LABORATORY OF THE UNIVERSITY OF KANSAS.

Switzerland. The difference of levels at Trieste and Amsterdam, measured *viâ* Silesia and Bavaria, appears to be 0.59 metre. Each of these four results (0.72, 0.66, 0.80, and 0.59) having a probable error of 0.1 metre, their accordance is quite satisfactory; and we may admit thus that the average level of the Mediterranean is in fact lower by 0.7 metre than that of the Atlantic.

—Many years ago the late Mr. Leonard Horner communicated to the Royal society the results of a series of borings which he had caused to be made in the upper part of the delta of the Nile, with a view of ascertaining the antiquity of the civilization of Egypt. Since that time, Figari Bey, an Italian geologist in the service of the Egyptian government, has made and published the results of a large series of borings effected in different parts of the delta; but his work is hardly on a level with the requirements of modern science. It has been thought advisable, therefore, by the British government, to take advantage of the presence of its troops in Egypt in order to carry out a series of borings across the middle of the delta, in the full expectation that such borings, if made with proper care, and carried down to the solid rock, will afford information of the most important character, and will throw a new light upon the natural and civil history of this unique country. Instructions have been sent to the officer commanding the engineers to undertake the operations; and it is hoped, that, before long, information will reach us which will be of no less interest to the archeologist than to the geologist.

— The committee of the British association for the advancement of science, consisting of Profs. G. H. Darwin and J. C. Adams, for the harmonic analysis of tidal observations, made its report at the Southport meeting of the association last year (1883). Professor Darwin, who is the author of the report, states, that, although it is drawn up in a form probably differing widely from that which it would have had if Professor Adams had been the author, the latter agrees with the correctness of the methods pursued. The general scope of the paper is to form a manual for the reduction of tidal observations by the harmonic analysis inaugurated by Sir William Thomson, and carried out by the previous committee of the association; and it is intended to systematize the exposition of the theory of the harmonic analysis, to complete the methods of reduction, and to explain the whole process. The method of mathematical treatment differs considerably from that of Professor Thomson; he having followed in particular, and extended to the diurnal tides, Laplace's method of referring each tide to the motion of an *astre fictif* in the heavens, considering that these fictitious satellites are helpful in forming a clear conception of the equilibrium theory of tides. Professor Darwin, however, having found the fiction rather a hinderance than otherwise, has departed from this method, and connected each tide with an 'argument,' or an angle increasing uniformly with the time, and giving by its hourly increase the 'speed' of the tide. In the method of the *astres fictifs*, the 'speed' is the difference between the earth's angular velocity of rotation and the motion of the fictitious satellite amongst the stars. The committee practically found itself engaged in the question of the reduction of Indian tidal observations; since it is only in that country that any extensive system of observation, with systematic publication of results, exists. Professor Darwin has discussed the entire subject with Major A. W. Baird, R.E., the officer in charge, at Poona, of the tidal department of the survey of India; and their general agreement as to the modifications to be made in the notation of the old reports appears to insure a harmonious course of future procedure. Major Baird returned to India in the spring of 1883, and lately began revising all the published results, so as to bring them into the uniform system here recommended.

— The southern part of the peninsula of California has recently been explored by Dr. H. Ten Kate, who reports (*Rev. d'ethnogr.*, ii. 321–326) that there are no longer Indians of pure race dwelling in that region. The blood of the ancient Pericuis and Coras flows, it is true, in a great number of métis; but they resemble the Spaniard far more than they do the Indian. In the graves of the dead few relics are found. Here and there on the cliffs are rock-paintings, a few of which Dr. Ten Kate reproduces. The paper closes with the account of a discovery in Sonora. M. Emeric has found upon the shore of the sea, about ten metres above the water-mark, under innumerable blocks of lava, objects resembling fishes and turtles cut out of marble and a hard green rock. He also found several stone knives smoothly polished.

— The Society of naturalists of Moscow has sent Kudriaotzeff to examine in detail the geology of the region drained by the upper waters of the Oka. Dokuchaeff undertakes similar studies for the region traversed by the Volga. Both these investigations are made at the special request of the authorities of the provinces named; and their results, combined with those already derived from the studies of Russian geologists for other districts, will go far toward a basis for a satisfactory geological map of this part of Europe.

— The calculation by Gladisheff, of Stebnitzki's astronomical data for the position of Ka-uchit Kala, the capital of the Merv oasis, has been concluded, and places it in 37° 35′ 19″ north latitude, and 59° 27′ 20′- east longitude, from Paris, — a position tolerably near that derived from older and less perfect observations.

— Some interesting facts regarding the public collections of American archeology in the United States are given by Henry Phillips, jun., in a paper to the American philosophical society. Judging by this report, there are six museums of the first class in this country, containing upwards of five thousand specimens, — the Academy of natural sciences in Philadelphia, the Davenport academy of natural sciences, the National museum at Washington, the Peabody museum of American archeology and ethnology at Cambridge, the Peabody academy of science at Salem,

and the Wisconsin historical society at Madison. To these must doubtless be added the American museum of natural history at New York, and the Peabody museum at New Haven, from which he received no reports.

Four museums should apparently be grouped in a second class as important ones, but not so extensive as those of the first class; namely, Amherst college, the New London county historical society, the Wisconsin natural history society of Milwaukee, and the Wyoming historical and geological society at Wilkesbarre, Penn. Eleven other museums are reported to have collections of considerable interest. To judge from the statements given in this paper, the Peabody museum at Cambridge is the largest in the country.

A list of twenty-five other institutions believed to have collections, and from which no information was received, is appended. We have already referred to two. It may be remarked concerning these, that the Boston society of natural history has no such collections, and that there is no institution bearing the title 'Academy of natural sciences, Baltimore, Md.'

— Dr. George M. Beard and Mr. Herbert Spencer almost simultaneously sound the alarm against our modern worry in the words, 'The gospel of work must make way for the gospel of rest.' An English writer, signing himself E. S., protests, in the *Journal of science*, against a theory of civilization which makes the acquisition of material wealth almost its sole object, and which brands all men not engaged in such pursuit as idlers. "We have under its inspiration stripped our own country, over a great and increasing part of its surface, of every beautiful feature. We have blackened its skies with smoke-clouds, polluted its air with sulphurous acid, filled its streams with liquid filth, covered its hills with 'spoil-banks,' blighted its green fields, cut down its woods, and extirpated many of its most lovely animal and vegetable species. Our cities, from London downwards, present, as their main feature, meanness, monotony, and ugliness by the square mile; rarely, indeed, relieved by a street or a single building upon which the eye may rest without pain." The diseases caused by over-work, public morals, and the effect of our system on true intellectual progress, receive vigorous treatment. The author concludes that our industrial civilization is found wanting in every particular. "It has broken down more rapidly and more disastrously, even, than the military *régime* which preceded it, and will be found to have left upon the human race even deeper marks of its failure."

— About half way between the mouth of the Santa Cruz River and the base of the Andes, and situated along the left bank, Signor Moreno has discovered an eocene deposit rich in mammalian remains. It lies at the base of an elevated terrace some eight hundred and twenty-five feet in height, and is made up of alternate lacustrine and marine strata (eocene, miocene, and pliocene), whose summit is mantled by an extensive accumulation of glacial detritus. The most important find here was the skull of a huge mammalian named by Burmeister 'Astrapotherium patagonicum,' and by him supposed to be closely related to Brontotherium, but which Moreno (under the new name of Mesembriotherium Brocae) considers to be a generalized type of marsupial, probably aquatic in its habits, and having certain characters in the skull to ally it with the Carnivora. In the same deposit were found the remains of a true marsupial. At a somewhat newer horizon, Moreno found the skulls of two genera of small-sized mammalians, which form a direct transition between the rodents and toxodonts. No traces of either miocene or eocene edendates were detected. In a deposit apparently transitional between the cretaceous and eocene were found two molars, with part of the cranium, of an animal (Mesotherium Marshii) whose true position has not as yet been absolutely ascertained, but which appears to represent the most ancient South American mammalian thus far discovered. Contrary to the opinion of geologists before him, Moreno considers Patagonia as the region whence the mammalia (late tertiary and quaternary) of the more northern regions have been derived. Instead of there having been a late southward migration into Patagonia, it is contended that a northerly migration set in with the advent of the glacial period; of which last, it is further claimed, there is convincing evidence. Patagonia is believed to have been united with the Antarctic continent on the one hand, and with Australia on the other.

— One of the reasons which led to the construction of inductive coils of the large diameter, employed by Professor Rowland in his present work on the ohm, is the hope of using them in a determination of the ohm according to the method of Lorentz. Their large size will admit of the use of a revolving-disk of more than half a metre in diameter.

— *The auk*, a quarterly journal of ornithology, the continuation of the *Nuttall bulletin*, as the organ of the American ornithologists' union, begins with January, 1884, under the editorial supervision of Mr. Allen, with Dr. Elliott Coues, Mr. Robert Ridgway, Mr. William Brewster, and Mr. Montague Chamberlain as associate editors, and with Messrs. Estes & Lauriat as publishers, necessitating the same general character as heretofore the *Nuttall bulletin* has borne, but with increased size and enlarged facilities.

— The Saturday lectures under the auspices of the Anthropological society and the Biological society of Washington will be delivered this year, as heretofore, in the lecture-room of the U. S. national museum, Saturday afternoons, at half-past three o'clock, beginning Jan. 5. The series will include twelve or more lectures, and will be divided into courses of four lectures each. The programme for the first course is herewith presented. The lectures are free, and the public are invited to attend. Jan. 5, Mr. Grove K. Gilbert, Cliffs and terraces; Jan. 12, Professor Otis T. Mason, Child-life among savage and uncivilized peoples; Jan. 19, Professor Edward S. Morse, Social life among the Japanese; Jan. 26, Major J. W. Powell, Win-tun mythology.

SCIENCE.

FRIDAY, JANUARY 18, 1884.

COMMENT AND CRITICISM.

The Philadelphia local committee for the reception of the American and British associations for the advancement of science, which will meet in that city on the 3d of next September, is taking active steps to make the meeting a memorable one. The well-known hospitality of Philadelphia, together with the unusual attractions offered by the combined meeting of the two great scientific bodies, will undoubtedly secure a very large attendance. Under the auspices of the Franklin institute, an international electrical exhibition will be opened simultaneously with the meeting of the associations, and a congress of electricians will at the same time be convened. Excursions of unusual interest and extent are being planned. Hon. John Welsh is president, and Prof. H. Carvill Lewis and Dr. E. J. Nolan secretaries, of the local committee, which consists of a hundred and fifty of the most influential citizens, representing all the prominent institutions of the city. Communications for the local committee should be addressed to its headquarters, — the Academy of natural sciences. The meeting will probably be held in the buildings of the University of Pennsylvania, which have been offered for that purpose.

It is sincerely to be hoped that the local committee at Montreal will take no steps which, by excursions or otherwise, may prevent a full attendance at Philadelphia of members of the British association. The committees at Montreal and Philadelphia should work harmoniously, arranging for combined excursions at the close of the Philadelphia meeting. With the aid of the Montreal committee, the Philadelphia meeting can be made the most important scientific gathering that has ever been held in this country.

Mr. Theodore Link, in the *Naturalist* for December, pleads forcibly for the betterment of zoölogical gardens. These ordinarily are, indeed, to speak paradoxically, nothing but stationary travelling-shows, — Barnum's menageries called to a halt. What is required for the animals' happiness and health is obvious enough; but, as questions like the present are generally decided from man's point of view, let us shift to that. The mission of these gardens, as Mr. Link says, is ostensibly "the study and dissemination of a knowledge of the natural habits of the animal kingdom." Therefore an opportunity for such habits among these animals is essential to the student visiting them. Perhaps most visitors, however, go for amusement, or for the pleasure of easy instruction. We go to see something opposite to the restraints of our own civilization, to behold the wonders of untrammelled instincts, to enjoy the beauties of free motion. But as it is, we seek a pleasure-garden, and find it a prison. We find no animated vigor there to cheer and to excite us, but helpless misery too much like the poorer side of human life.

The great difficulty, it seems to us, is in attempting with limited means too big and miscellaneous collections, imperfect, unsatisfactory, and uninstructive, about in proportion to their excess of size. Would it not be better in a given half-acre to have a single pair of lions, or of any other much admired brute, rather than a subdued camel, a cramped tiger, a dilapidated ostrich, and a discouraged crocodile, all obliged to stand as nearly as possible on one leg, for want of any thing better to do? Any chance and inducement given to the animals to breed naturally and freely, certainly might be a direct and valuable economy to any zoölogical society in keeping up its stock.

According to a communication made to the London section of the Society of chemical in-

dustry by Mr. Weldon, it does not seem that we are much nearer to cheap aluminium than we have been for a long time. A short time since, it was announced that a new method of production had been invented and was in use; but Mr. Weldon says this invention only relates to the production of anhydrous alumina from potash alum; and, if the method of obtaining this were fifty per cent cheaper than that of M. Pechiney of Salindres, it would only cheapen aluminium by five per cent.

Apropos of the present discussion of the excessive requirements of Greek and Latin in our colleges, let us not forget the neglect of English. One of the reasons most commonly given for the study of the ancient languages is that they aid the understanding of our own. This is undoubtedly true, but they are not the best aids; and if a good understanding of English be the desired end, as it certainly should be, there can be no question that it will be sooner and better attained by the study of English itself. The derivation of our words can be very satisfactorily taught along with advanced spelling, and the meaning of a large number of roots, prefixes, and suffixes, can then be acquired, so as to give most practical assistance to the comprehension of English; much better, we venture to say, than if etymological study be limited to the languages from which the roots, prefixes, and suffixes come, and direct statement of their use in building up our own language be omitted. It is certainly very common to find students who have 'passed' in Greek and Latin still unable to explain the meaning of not unusual scientific terms. Indeed, so large a share of the time allowed to linguistic study is now given to Greek and Latin considered simply as dead languages, without reference to their living descendants, that no time is left in which the general student can learn what he certainly should know about his mother-tongue.

There is pressing need of collegiate study of English as a language: and few subjects would be more attractive than this might be made by a lecturer who would tell his class where and when the language attained enough of its present characteristics to be entitled to its present name, what were its ancestors, and how they mingled and changed their form in producing their descendant; who would describe how the language itself has varied in recent centuries, and how its unsystematic spelling, so unlike the phonetic simplicity of Italian and Spanish, depends on its complex origin; who would point out the historic reasons for its *dependence* on earlier languages for words expressing abstract ideas, in contrast with the relative *unabhängigkeit* of German. All this would no more require a knowledge of ancient or foreign languages than an appreciation of elementary lectures on chemistry needs an understanding of organic analysis; but it would give a very different knowledge of English from that derived from the study of Latin declensions and Greek accents. We cannot doubt that it would be of great service to all who have to write out what they think, and that it would attract to philological studies many students who are now repelled from them.

We understand that the scientific work of the Army signal-office is likely to form a feature of increasing importance in the future development of that department, and that Gen. Hazen desires to secure the services of the best talent in the country. It would seem that the study of mathematics, mechanics, and physics, as bearing on meteorology, has been sadly neglected in our universities; and it is by no means easy to find any who have been studying the sciences with a view to the pursuit of investigations in meteorology. As a general rule, those who have studied and practised astronomy for a few years are the best prepared to advance meteorology. The fine library of the signal-office, its unequalled mass of observations and maps, its courses of lectures, its annual classes of men under instruction at Fort Myer, its collection of apparatus, all offer to young meteorologists opportunity and stimulus to farther advancement; while the publications of the office offer every facility for making known the results of origi-

nal investigations. Even meteorologists outside the office, or employed by it as consulting specialists, may find it to their advantage to avail themselves of this opportunity for publication. Considering the great future evidently in store for meteorology, it is not surprising that Professor Abbe is, as we understand, diligently inquiring for those who are willing to come to his assistance in the effort to develop a systematic, deductive, and exact science of meteorology. We commend this subject to those whose studies have taken this direction. There are needed the investigator, the teacher, and the expert consulting-meteorologist, precisely as in other branches of science.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Chemical geology.

IT appears to me, that in his interesting communication in the number of *Science* for Dec. 28, Professor Winchell has fallen into an error, which, while diminishing by more than one-eighth his estimate of the secular increase of the earth's mass, is yet more serious from the stand-point of chemical geology. In determining the amount of carbon dioxide abstracted from the atmosphere and fixed in the earth's crust, he estimates, first, that represented by the carbonate rocks (limestone, dolomite, etc.), and, second, that required for the decomposition of an assumed thickness of decomposable silicate rocks; and both these amounts are included in his grand total. But this is certainly bad book-keeping, for a portion of the carbon dioxide is counted twice. The decay of the silicate rocks is a necessary antecedent of the formation of the carbonate rocks; and the carbon dioxide of the latter is precisely the same as that which has previously decomposed the former. In general terms, this grandest of all chemical processes proceeds as follows: the carbon dioxide of the atmosphere decomposes the felspars, hornblende, augite, micas, etc., of the silicate rocks, leaving the alumina and iron with the silica as a more or less ferruginous kaoline, and forming carbonates of the alkalies and alkaline earths, which are carried away in solution, and ultimately reach the sea, where the latter are deposited as limestone and dolomite, and the former react with the calcium and magnesium chlorides of the sea-water, producing alkaline chlorides (chiefly common salt) and more limestone and dolomite. As Dr. Hunt has so clearly shown, the kaoline on the land, and salt in the sea, are merely incidental results of the fixation of the carbon dioxide of the atmosphere in the carbonate rocks.

W. O. CROSBY.

Osteology of the cormorant.

Dr. Shufeldt's letter in *Science* (ii. 822) calls for a few remarks. In relation to his first statement, that 'the occipital style of the cormorant is not an ossification in the tendon of any muscle' of the neck, Selenka wrote as follows: "Eigenthümlich ist dem Carbo cormoranus und C. graculus, aber auch nur diesen beiden, ein an dem *occip. superius* durch bandmasse verbundener, dreieckig pyramidenförmiger, nach hinten gerichteter knochen, welcher die ansatzfläche der den kopf bewegenden muskeln soz. vergrössert; er ist ein sehnenknochen und gehört nicht zum schädel" (Thierreichs, 19). In view of such eminent authority, it would seem that something more than simple denial is required to upset a statement accepted by anatomists for many years. It is worthy of note that Dr. Shufeldt does not mention the nature of the bone in his article, and that, in ignoring the point to which I took exception, he virtually acknowledges his mistake. It is difficult to understand how one who does not know the position of a bone is qualified to expound its nature; and in all cases it is wise, if we would convince, to give reasons for dissent from authorities.

As to his second statement, that my ideas of the morphology of the rotular process are wrong, I would simply remark that the ideas referred to are not mine, but those of Nitzsch, of Meckel, of Tiedemann, of Owen, of Selenka, and of Mivart, and suggest that it would be appropriate to read such eminent authorities before disposing of them with an empirical denial. Dr. Shufeldt's paper clearly intimates that the rotular process of the divers is the homologue of the patella in other birds. The coexistence of the two disproves this by *reductio ad absurdum.* I would invite Dr. Shufeldt to quote the passage to which he refers when citing Owen as considering any process of the tibia as the analogue of the patella.

Lastly, Dr. Shufeldt states "that, furthermore, I find myself misquoted more than once." I would remind Dr. Shufeldt that I quoted him but once; and of the accuracy of this, any one may satisfy himself by referring to *Science*, ii. 642, 2d column, line 19.

J. AMORY JEFFRIES.

Electric time-signals.

Your correspondent who describes his method of making electrical signals in a recent number of *Science* (ii. 823) can greatly simplify and thereby improve his arrangement by inserting within the clock a couple of thin metallic springs with platinum contacts, the circuit being completed by the pressure of the hammer on the 'outward stroke.' The writer has had such an attachment to an ordinary 'programme clock' in constant use for about ten years, as is doubtless the case with many others who have had occasion to distribute time. The signals are transmitted to several buildings, in one of which an electric gong is struck, and in others a number of 'vibrating' bells are rung.

Mercury contacts are generally troublesome. The arrangement described seems unnecessarily complicated: besides, it is difficult to see the necessity for insulating the clock 'on a square of plate glass.'

M.

Columbus, O.

Capitalization of names of formations.

The use of capitals is a literary rather than a scientific matter; but geologists, nevertheless, suffer as a class from the existing confusion in regard to the names of formations.

Authors who are consistent with themselves in this matter fall into three classes. Those of the first class speak of the *P*otsdam, and of the *C*arboniferous, but of *p*otsdam strata and *c*arboniferous strata. In so doing they class the names of formations as proper nouns, but refuse to recognize proper adjectives. This practice employs a German idiom not otherwise countenanced in our language: we do not say *g*erman

idiom. Another objection is, that the practice introduces a distinction difficult to maintain on account of the graduation of the nominal into the adjective sense. 'The Carboniferous' may or may not imply some such noun as formation, and the degree of such implication is variable.

Authors of the second group speak of the *P*otsdam and *P*otsdam strata, but of the *c*arboniferous and *c*arboniferous strata. The distinction thus made is etymologic, being based on the immediate derivation of the name of the formation. To this there are two objections. First, it is contrary to the analogies of the language, for capitalization is generally controlled by meaning. We speak of 'the *P*acific,' although the designation is etymologically a common noun; and we call the recently popular feminine waist-gear a *j*ersey, although the designation is etymologically a proper noun. Second, it has the effect of recalling attention continually to the derivation of names, and thus retaining their connotative meaning. For mnemonic reasons, and for these only, it is convenient that names of formations should originally be connotative, but it is of prime importance that they should eventually become merely denotative. There was a certain original utility in having 'Potsdam' call to mind a place, and 'carboniferous' a character; but the names having become securely attached to their several formations, it is now imperatively demanded that each shall designate a certain portion of the stratigraphic column and a certain portion of geologic time, without connotating place or composition. Indeed, the reason why modern usage employs geographic terms in the naming of new formations, instead of designating them by their physical characters, is that a minimum of connotation is thus secured from the outset.

Authors of the third class capitalize all names of formations, whether used as nouns or adjectives, and in so doing escape these evils. The only objection I see to their practice is, that it classes with proper nouns a group of names which may fairly be compared with other groups not so classed. The demarcation between common and proper nouns is essentially somewhat obscure; and the drawing of the line is largely a matter of practical convenience. It is noteworthy that no author whatever has so drawn it as to include all names of formations with common nouns.

The capitalization of all formation names has the manifest advantage that it enables one to say that the *C*arboniferous rocks are not the only *c*arboniferous rocks, or, in other words, that it does not deprive the geologist of the independent use of words indicative of rock character which have been appropriated for the names of formations. If the use of capitals were altogether discarded in the designation of formations, this advantage would be lost, but another would be gained; for we should then be able to speak of the rocks of *P*otsdam without implying their *p*otsdam age.

G. K. GILBERT.

Remsen's 'Theoretical chemistry.'

Will you kindly allow me to correct an error into which it seems that I fell, in my notice of Professor Remsen's 'Theoretical chemistry' (*Science*, ii. 826)? It cannot be denied that the statement, "Of the substitution products of benzene which contain three substituting groups, more than three varieties have been observed," is literally true. The context and form of expression were such that I could not but think this assertion was made of those derivatives in which the three substituting groups were alike. Had it occurred to me that the statement was not thus limited, I certainly should not have pronounced it rash, but so cautious and incomplete that it must inevitably mislead even the most careful reader.

THE CRITIC.

Synchronism of geological formations.

I trust that you will permit me a little more space to reply to the further remarks of Mr. Nugent on this subject (*Science*, iii. 33), seeing that your correspondent has failed to grasp the point which I had intended to elucidate in my last communication.

Mr. Nugent is correct when he contends that I rest my case on the non-occurrence of 'evidences of inversions;' and, if my line of argument based on this fact fails to meet with his approval, I sincerely regret it. Paleontology, as far as I am aware, has thus far failed to show a single unequivocal case of faunal inversion such as I have indicated; nor does there appear at the present time very much likelihood of its ever being able to do so. Nor would the discovery of a solitary instance materially affect the question, inasmuch as, upon the theory of very broad contemporaneity suggested by Huxley, instances of inversion ought to be about as numerous as those of non-inversion. My courteous critic admits that "there is no reason why such instances of inversion should not have occurred over and over again," and that at the present time their 'occurrence is almost unknown;' but his appeal to the 'imperfection of the geological record' (both geological and geographical), in explanation of the overwhelming negative testimony, will, I am afraid, scarcely meet the situation.

The special cases referred to — Barrande's colonies, and the intermixture of Silurian and Devonian, and Devonian and carboniferous fossils in the old red sandstone of Scotland — are far from being of the character desired. The former need scarcely to be commented upon, since they have always been involved in a certain amount of obscurity; and their very existence as such has very recently been denied by Marr, who personally examined the region, Lapworth, and a host of other geologists. In the case of the old red sandstone of Arran, where there is an intercalation of a band of marine limestone containing Productus giganteus, P. semireticulatus, P. punctatus, Chonetes hardrensis, Spirifera lineata, and other well-known carboniferous fossils, Professor Geikie (who, we believe, first made the observation) distinctly affirms that these organisms must "have been in existence long before the formation of the thick Arran limestone," and that their habitat during the period of the deposition of the underlying sandstone was immediately outside of the basin or basins that through upheaval were now being gradually isolated from the sea: in other words, we have here merely an instance where the range of a certain number of organic forms has been extended somewhat lower down in the geological scale than it had hitherto been indicated. These same forms re-appear in the superimposed lower carboniferous limestones, and, as Professor Geikie observes, they must have been living during the long interval coincident with the sedimentation of the intervening sandstone 'outside of the upper old red sandstone area.' The same relation holds with the Siluro-Devonian mixture in the basal old red of Lanarkshire. No one can deny the local displacement and interchange of portions of two consecutive faunas, especially at about the beginning or close of their own respective series; but these displacements are not of the nature of the inversions that ought to illustrate the doctrine of broad contemporaneity.

To what extent similar or identical faunas indicate *absolute* chronological relationship can probably never

be determined; but I believe it may be safely assumed that the synchronism is defined within comparatively narrow limits; or, as previously expressed, "formations characterized by the same or very nearly related faunas in widely separated regions belong, in very moderate limits, to approximately the same actual age, and are to all intents and purposes synchronous or contemporaneous" (*Science*, No. 41). Professor Geikie, who is quoted by your correspondent as supporting the orthodox doctrine of homotaxis, or homotaxis in its broadest limits, judiciously refers to chronological divergences of only *thousands* of years, and *not* of *millions* ('Text-book of geology,' pp. 617–619). ANGELO HEILPRIN.

Academy of natural sciences, Philadelphia, Jan. 12, 1884.

Free cervical ribs in the human subject.

I send you a photograph of a notable and very interesting anatomical preparation well worthy of being engraved and published in *Science*. It is the seventh cervical vertebra of the human subject, natural size, viewed from above, showing a pair of free cervical ribs. This demonstrates the fact that the so-called transverse process of a cervical vertebra consists of a diapophysis with a coalesced pleurapophysis, the vertebrarterial foramen so characteristic of cervical vertebrae being an opening between these two apophyses. The photograph shows the preparation so well that little description is required. The whole bone is seen to be a little distorted, and the two ribs are seen to be of different shape and size. The ribs are photographed a little apart from their respective articulations, otherwise *in situ*. Each freely articulates, as usual with ribs, by its head with the body, and by its shoulder with the diapophysis, of the vertebra. The base of each diapophysis presents anteriorly a nick (deeper and more regular on the left than on the right side) which is a part of the vertebrarterial foramen proper, the rest of which is circumscribed by the rib itself; the whole space between the vertebra and the neck of the rib being thus a large continuous opening of irregular contour.

The lower border of the body of this vertebra presents on each side a demifacet (not shown) for half of the head of the next (first dorsal) rib; so that the first dorsal vertebra must also have been anomalous in possessing two demifacets, instead of a full facet above and a demi-one below. The same subject was also badly put together in some other respects; e.g., one of the long thoracic ribs (I think the fifth) bifurcated at the sternal end. The specimens were handed to me by one of my pupils, Mr. Arthur J. Hall. The anomaly here figured, while not new, is so rare that I think I have seen but one illustration of it; namely, that given by Professor Owen in his 'Comparative anatomy and physiology of vertebrates.'

ELLIOTT COUES.

Smithsonian institution, Washington, Jan. 4, 1884.

Seventh cervical vertebra of the human subject, life size, seen from above; showing well-developed and freely articulated pair of cervical ribs.

A possible solution of the standard time question.

Although the adoption of five standards of time for the movement of railroad-trains in the United States has simplified the time question for the travelling public, I believe it is a matter of deep regret, that, since a change has been made, that change could not have been to a single standard instead of five, and that Greenwich time, as Mr. Schott very significantly queries in *Science*, No. 38. This is the more to be regretted, since the railroad companies have found it impracticable to make the changes on the proposed meridians, and since, as Mr. Schott rightly apprehends, all ordinary business must always be conducted on local mean solar time.

It appears to me that this whole question could be very simply and forever settled by the adoption of Greenwich time for the movement of all public conveyances the world over, and the construction of time-pieces which would indicate at once both local mean solar time and Greenwich time. The only modification of the ordinary time-pieces needed, to enable them to indicate both times, is to provide them with two dials, one of which shall be movable about an axis, and capable of being set at any desired point. It is immaterial which dial is stationary: the same set of hands would sweep both dials, and indicate, of course, both times, at once. Thus provided, a person desiring to take the next train would be governed simply by the Greenwich dial. Furthermore, should his time-piece lose or gain, it would only be necessary to set it by either local mean solar time or by that of

any station, to have it right again both at home and with the world.

The adoption of such a standard would not necessitate the substitution of new time-pieces for those now in use, nor expensive alteration of them. A very simple, inexpensive way of adapting existing watches to the suggested change would be to etch the Greenwich dial upon the watch-crystal in a little smaller circle than that of the dial proper. The crystal could then be set to indicate the difference of time between the given place and Greenwich, and secured by a little white wax. Clocks could be similarly changed also.

If the hours are to be read from one to twenty-four, as seems desirable, and as some roads have already agreed to do, this will necessitate not only a change in the rate of motion of the hour-hand of time-pieces, but in the dial also. Now, since a change is to be made anyway, why not avoid twice changing by reconsidering at once the action already taken, and move immediately in the direction Mr. Schott has suggested. This would avoid the necessity of publishing in time-tables local times; while the traveller would have simply to consult his time-table, and refer to his Greenwich dial, to know at what moment to take a public conveyance, not only anywhere in the United States, but anywhere in the civilized world. Train-men and station-hands could experience no inconvenience in being guided by their Greenwich dial, it being necessary simply to make that dial the more conspicuous which is to be consulted oftenest.

F. H. KING.

River Falls, Wis.

THE DUTY ON IMPORTED SCIENTIFIC TEXT-BOOKS.

AT the last meeting of the American association for the advancement of science, there was some discussion of the effects of the existing tariff on foreign text-books on our school system. This is the first considerable effort to call the public attention to the results of our Chinese commercial policy upon the education of our youth. That system of policy is such a vast elaboration of rules, and the effects of its regulations are so hard to trace in the machinery of our society, that it has derived a strength and a safety from its very magnitude and its obscurity. The ordinary mind shrinks from the effort to trace the complication of its effects on great labor-employing industries like pig-iron manufacture. It requires the courage of a great soldier to give battle to the tariff on such fields; for, however convinced the free-trader may be of the right of his cause, he sees that his victory will mean destruction to many whom he cannot regard as foes. But here and there around the tariff jungle there are places that may be improved without danger of any serious consequences to great interests. Some years ago, in a lapse into discretion, if not into rationality, the tariff men took off the duty on quinine. A few score men had to seek other employment, probably to their serious but not permanent inconvenience, and that greatest of all helpers of the sick was free to go untaxed to its users.

As real though less sympathetic claim may be urged for the removal of the tax on educational materials and methods. Even in our money-earning state of society the amount that can be spared for the education of our children is so small that such money should be the last thing to receive the burden of taxation. What would have been thought, if in the fiercest struggle of the war, when we were taxing the physician's right to minister and the drug's power to heal, if some legislator had proposed to tax each college-student, say, three dollars a year, for the privilege of pursuing his education in the most effective manner? Taxes on this principle may be warranted in a besieged city; but even on our darkest day such a measure would have been laughed out of Congress, would have been denied even the rites of decent burial in a committee. Yet substantially this is what is practically done in this day of unparalleled prosperity, when, for the first time in all history, a government is sore burdened with its revenues. A commission of well-paid experts, charged to contrive some means to clear away this excess of income, retains this amazing tax after a year of pondering on the subject!

The singular character of the tax is evident enough in the most general statement of its nature, but close inquiry shows us that it becomes even less comprehensible the better we understand its details. The books excluded by the tax are not the spellers, readers, arithmetics, etc., that are made by the million. Against these, no foreign books would stand any chance whatever, unless they were introduced to the schools through the existing publication-houses. The books that are affected by the law are those that have at best a narrow sale. They are principally books in French, German, Latin, or Greek, used only in college classes for special purposes, which it would not pay any American publisher to reproduce. But let us suppose that the English, German, or other printers could furnish a set of school-books so decidedly better and cheaper than our own that our thrifty publishers should be driven from the field: will any reasonable man say that we should continue to maintain them by a head-money tax on the pupils of our schools?

There is no good reason to fear that our publishers would lose by a free trade in educational materials. If the change be made in such fashion that they may have as good a chance in foreign markets as foreigners should have in our own, we can trust the business

capacities, and the stimulated energies of our text-book makers, to keep our place in the struggle. But grant the truth of the sad presages of those who see the deluge in free trade, can we afford either the principle or the effects of levying a poll-tax on education?

WHIRLWINDS, CYCLONES, AND TORNADOES.[1]—VIII.

THE barometer was falling more and more rapidly, and the wind blowing with increased violence from the north, in the example that was described. Then, if a transparent storm-card, drawn to proper scale after the pattern of fig. 9, be placed on the chart so that its strong north wind shall pass the position of the vessel, it will give the best indication of the general form of the hurricane; and a course may be laid by which the dangerous centre will be avoided. In this case, the safest course will be to run southward, or a point or two west of south, till the barometer begins to rise; and then, if desired, a more easterly course may be followed. Even if the vessel be on its way to a European port, this will be its safest method of avoiding the storm; for, in attempting to beat against the wind and leave the storm to the south, there is too much risk that its increasing strength will prevent the vessel making sufficient headway to escape being caught in the central whirl: it would be better to sail around the southern side of the storm, and, after the centre had passed on the west, then shape a north-easterly course with the wind on the starboard beam. Sometimes it has happened from ignorance of such sailing-rules as these, or from inability, even with their aid, to escape from the sudden violence of a storm, that a vessel finds itself on the storm-track at the time of the passage of the centre; and there is then observed the peculiar and dreadful calm within the whirl, to which sailors have given the name of 'the eye of the storm.' Let us suppose, in the example given above, that the vessel endeavored to force its way against the increasing north wind, and, failing in this, remained on the path of the storm till the centre advanced on it. During its approach there will be no very marked change in the direction of the wind; but its force increases even beyond what seems its greatest possible strength, and goes on increasing, blowing in tremendous and terrible gusts, till the vessel is stripped of its canvas, and the yards and masts are cracked and broken away, and the hull lies helpless and unmanageable. Rain falls in driving torrents, and the sea rolls in great broken waves. The roaring of the winds rises to a screaming pitch; and when at its most fearful strength, it suddenly dies away. In five minutes, perhaps even less, the air is quiet; and only the heavy sea, and the commotion of the clouds, and a distant fading sound of the retreating wind, tell of the violence that has passed by. The vessel is in a cushion of quiet air left under the core of the storm. There is generally but a short time given to suffer the suspense of this unnatural quiet. In half an hour or an hour, according to the size and rate of motion of the storm, the centre passes away, and the opposite side of the whirl suddenly falls on the unhappy wreck, coming again with all the roar and fury that was felt before, but now blowing in the opposite direction, — a terrific hurricane from the south, chopping the waves into the dreaded cross-sea, where the water rises in pyramids instead of in linear crests, and changes its form so rapidly and with such broken rhythm as to strain great leaks in the worn-out hull, and leave it to founder in clearing weather, while the storm goes on in its destructive path.

There is yet much to be learned concerning the curves followed by the winds in these storms. The diagrams, as described above, are based on observation and theory, but must be regarded only as provisional until proved by the average of many more observations than have yet been made. Rules for various cases may be easily devised on the plan above described, but they are not infallible: there is still much to be done in perfecting them. Only one additional point need be mentioned: care is needed to avoid sailing after and overtaking a slow-moving storm, and so falling into its power. This would seldom happen in our latitude, but might well occur in the Indian Ocean, where some storms have been found to rest almost stationary over one district of the sea for more than a day. A case is reported where a vessel thus fell into the dangerous whirl, and could not escape, but was carried round and round the centre, while scudding under bare poles, till it made five complete revolutions before the storm left it behind.

There remains to be described the storm-flood produced when a storm runs upon a low shore, as often happens at the head of the Bay of Bengal. The cyclone advances with growing strength till it reaches the flat delta of the great Indian rivers. It finds the land here perfectly level, and so little raised above the water that its cultivated surface has to be pro-

[1] Continued from No. 48.

tected from river-overflows by dikes ten or twelve feet high built along the shores. But the inblowing winds brush the water of the bay up against the land; the diminished atmospheric pressure about the storm-centre allows the heavier surrounding air to lift the water here, and for every inch that the mercury falls in the barometer the water will rise a foot; the rain alone may contribute nearly a foot of water in a day; and finally, if a strong tide conspire with these other causes, a great flood is produced, that overwhelms even the dikes, and drowns out all the low country; and the poor people, unprovided with sufficient means of escape from the winds and the waters that come from above and below, are lost by the thousand. Six storms alone, that have devastated this coast since 1700, have, if the records can be trusted, destroyed over half a million lives.

The disappearance of a storm has already been alluded to. The storm will fail, or greatly decrease in strength, when running from the sea on the land; for friction here is greater, and there is less moisture in the air from which heat can be obtained to overcome the increased friction and continue the existence of the disturbance. Again: the storm must decrease in intensity as it recedes far from the equator; for it then enters regions of less warmth, and consequently less moisture. Finally, it must end when the updraught caused by heat derived from the falling rain fails to throw the overflow outside of the storm's limits; for then more air enters the storm than flows out of it, and the pressure at the centre will increase. The reverse of this is worth noting: the storm will increase in size and in total strength, although perhaps not in central intensity, as long as the updraught is active enough to throw some of its volume outside of the area occupied by the surface-indraught; for then the pressure at the centre will decrease, and the development of the embryo will continue.

Before proceeding to the consideration of tornadoes, we may devote a little space to the special features of our own storms east of the Rocky Mountains, as determined chiefly by Professor Loomis in his careful study of the signal-service maps.

The storm-areas, as indicated by the curved lines of equal pressures, are ovals about twice as long as wide, with the longer axis generally north-east and south-west. The average direction of progression of nearly five hundred storms, in 1872–74, was north 81° east, with a mean velocity of twenty-six miles an hour, or six hundred and twenty-four miles a day: the maximum velocity was above eighteen hundred miles a day. Some of these barometric depressions begin on the Pacific Ocean, or in our north-western territories; most of them are first noted within the western mountainous district; and a good share of the remainder arise on the plains. Very few come from the West Indies. After passing us, they sweep out over the ocean, generally turning well to the north-east, and, if continuing long enough, running to Norway or Iceland rather than to Great Britain. The probability that a storm which leaves our coast will arrive in England is only one in nine. The average tracks of a large number of storms from the Rocky Mountains to the Ural are shown on the accompanying map, prepared by Köppen (*Annalen der hydrographie*, 1882).

If storms moved only according to these averages, their prediction would be made easy and accurate; but they naturally fail to do so, and hurry or slacken their pace, or turn to one side or the other of their average course, in what seems to be the most capricious fashion. It is the early discovery of these individual peculiarities that tasks the acuteness of the weather-men.

With regard to velocity, storms advance much faster in February than in August (174 : 100), and in the late afternoon and evening than at other hours (125 : 100). If the telegraphic reports show a rapidly rising barometer, and a weak wind in the rear of the storm, it will probably move rapidly. The rain, also, exercises a marked control on the storm, as is shown by comparing the forward extension of the rain-area with the rate of progress: —

Forward extension of rain.	Progression of storm-centre.
640 miles.	40.1 miles an hour.
568 "	29.2 " " "
539 "	22.3 " " "
422 "	15.3 " " "

further, by comparing the axis of the rain-area with the course of the storm: —

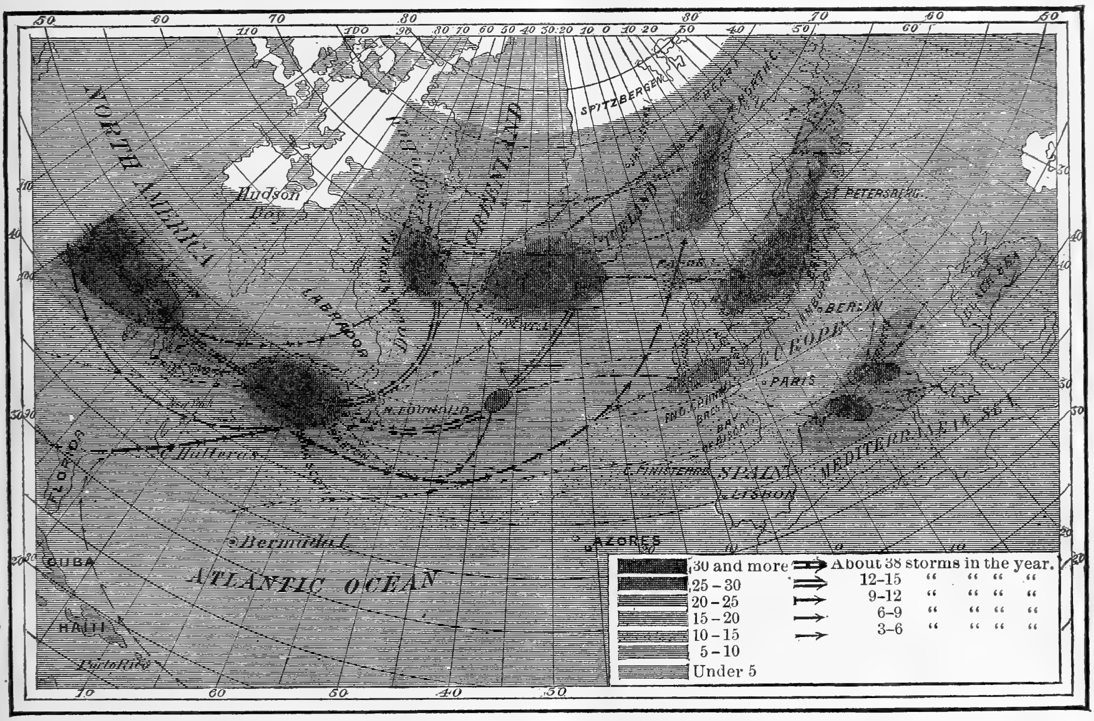
Axis of rain-area.	Course of storm.
N. 53° E.	N. 44° E.
S. 65° E.	S. 69° E.

finally, by comparing the rainfall with the increase or decrease of the central barometric depression: —

Average rainfall within isobar 29.80″.	Change of central depression in twenty-four hours.
0.078″	+ 0.10″ (i.e., storm decreasing).
0.149	− 0.05
0.159	− 0.128 (i.e., storm increasing).

Rain, therefore, is shown to aid in determining the velocity, direction, and development of our storms, as has already been inferred.

Thus far in regard to the motion of the storm as a whole. The winds of the storm blow faster, the more marked the central depression and the closer the isobars. If the space on the signal-service maps between adjoining isobars (the difference of their pressure being one-tenth of an inch) measure one hundred and thirty miles, the wind will probably blow five miles an hour; if eighty miles, thirty miles an hour; if forty-five miles, fifty miles an hour. There is, however, much variation from this rule, depending on the form of the ground and the neighborhood of the lakes or the sea. The average direction, inclination, and velocity of our storm winds in the four quadrants is shown in fig. 21. The relation of the several inclinations here shown has already been discussed. It should be added, that the unexpected approach to equality in the wind's strength on the right and left (south and north) sides of the storm is probably in large part due to the wind on the north coming but little retarded from the sea, while that on the south has lost much of its proper velocity by blowing long over land; so that, while the winds should theoretically show a less velocity on the left than on the right side of the track when the storm moves over a uniform surface, this inequality might be largely counteracted by the relations of sea and land that obtain in the eastern part of our country. This is confirmed by finding the winds on the left side of the storms of northern Europe much weaker than on the right; for here the progression of the storm, and the relation of sea and land, combine to produce this effect. Our space forbids more detailed consideration of the variation of our storms with the seasons; and the reader desirous to pursue the subject farther should provide himself with the government daily weather-maps, which may be had by subscription to the chief signal-officer in Washington, and should consult Professor Loomis's essays in the *American journal of science* for



AVERAGE TRACKS OF STORMS FROM THE ROCKY MOUNTAINS TO THE URAL.

recent years, the circular on the practical use of meteorological reports and weather-maps (issued by the signal-service, 1871), and the appendices on the relation of rain and winds, and on the course of storms in the different months, in the signal-service reports for 1878 and 1874.

(*To be concluded.*)

THE INTELLIGENCE OF BATRACHIANS.

In his recent volume on Animal intelligence,[1] Mr. Romanes devotes less than two pages to the intelligence of batrachians. He remarks, 'On the intelligence of frogs and toads very little has to be said.' That our author should have included toads in the above seems strange; as instances of cunning, and proofs of the general intelligence, of these animals, are numerous. In conversation with practical observers of animal life, I have never yet found one that did not accord a marked degree of intelligence to toads. In short, toads may readily be tamed, will come when called, and have been seen to place matter attractive to flies, their principal food, near their hiding-places, so they could remain at home and at the same time be sure of a sufficiency of food. This evidence of foresight, on the part of toads, is no uncommon occurrence, and quite effectually establishes their claim to a creditable degree of intelligence.

Of the spade-foot or hermit toad (Scaphiopus solitarius) and the tree-toad (Hyla versicolor) I have but little to record. The former is but rarely seen, and I have had no opportunity to experiment with it with a view to testing its mental capabilities. The habits of the animal, as described by Agassiz and Putnam, would lead one to conclude that intellectually they are to be classed with the common toad. The tree-toad, or Hyla, being crepuscular in habits, was found difficult to study, and nothing was determined that bore upon the question of its intellectual capacity. I can but state my impression, which is, that they are not so cunning as the common toad.

On the other hand, I am pained to confess that my many observations and experiments with the several species of true frogs found here, conducted without an intermission for four months, have yielded but little evidence that these creatures possess a particle of intelligence. It almost proved, indeed, to be labor lost, —

'To perch upon a slippery log,
And sit in judgment on a frog.'

[1] Animal intelligence. By George J. Romanes. (Internat. sc. series, no. xliv.) New York, *Appleton & Co.*

Mr. Romanes remarks, that, if frogs are removed to a long distance from water, they will take the shortest route to the nearest pool or brook. Even this, I find, is only usually true. Quite ten per cent of such 'removed' frogs started off, when released, in the direction of the most distant water, rather than that which was nearest. One of my many experiments was as follows: I placed a pail filled with water in a dry, dusty field, burying it to the brim. It was protected by a cap of coarse wire sieving. I then liberated a frog within twenty yards of it. It hopped in the opposite direction, towards water nearly three hundred yards distant. I then placed a frog on the opposite side of the buried pail, so that the distant brook could only be approached by passing near or directly over it, if the frog took a direct course. This the frog did, and less than a score of leaps brought it to the water covered by the sieve. It seemed quite satisfied with the fact that a little water was in sight, although out of reach. Here the frog remained until morning. The following day I removed the pail, and buried it within fifty yards of a running brook. I then took seven frogs of three species, and placed them upon the sieve, which was about half an inch above the surface of the water. Here five of them remained during the whole day, exposed to the glare and heat of a cloudless midsummer day. The evaporation from the water beneath them barely kept them alive; and yet within so short a distance was a running brook, with all the attractive features of ideal frog-life.

I repeated this experiment, with slight modifications, several times, and always with essentially the same results.

In his Travels in North America (Eng. trans., vol. ii. p. 171), Peter Kalm refers to certain habits of the bull-frog (Rana Catesbyana) which seemed to indicate that the frogs of this species occupying the same pond were somewhat governed by a leader. His remarks are, "When many of them croak together, they make an enormous noise. . . . They croak all together, then stop a little, and begin again. It seems as if they had a captain among them: for, when he begins to croak, all the others follow; and, when he stops, the others are silent;" and he adds that the 'captain' apparently gives a signal for them to stop. This, if true, would be evidence of considerable intelligence; but it is only apparently true of them. I have very carefully watched the bull-frogs in a pond near my house, and have found that the croaking of the 'captain' is not always that of the same individual. At times

the initial croak would come from one side of the pond, then the other, and so continue to vary. This shows at once that not any one individual started and stopped the croaking of its companions.

Hoping to find that in the pursuit of prey, which is principally insects, frogs would display some intelligence, I tried several experiments to test their ingenuity; but it was of no avail. Unless the food could be easily reached by making the simple exertion of a single leap, the frogs would go hungry. Subsequently I placed a large fly upon a piece of thin mica, and surrounded it with a circle of fine needles, piercing the plate. The fly thus protected could only be seized by the frog suffering a severe pricking of the jaws. This, I found, a frog would suffer indefinitely, in its attempts to secure the fly. In one instance, the frog, which had been fasting for seventy-two hours, continued to snap at the needle-protected fly until it had entirely skinned its upper jaw. I concluded from this, that the wits of a frog were too limited to be demonstrated.

Some weeks after having completed these experiments, I had the good fortune to capture two fully grown specimens of the bull-frog (Rana Catesbyana); and, noticing their enormously distended sides, I examined the stomach-contents of the two. In one was a full-grown chipmunk (Tamias striata); in the other, a garter-snake (Eutania sirtalis) measuring eighteen inches in length, and also a field-mouse (Arvicola riparia). On close examination, I found that the snake had partially swallowed the mouse; and, while thus helpless, the frog had evidently attacked the snake, and swallowed it.

It is evident, I think, that the frog recognized the helpless condition of the snake at the time, and took advantage of it. If so, it is evidence of a degree of intelligence, on the part of the frog, which the results of my experiments on the frogs generally, had not led me to expect. Certainly a frog, however large, will not attack even a small snake if it is possessed of its usual activity.

The salamanders, on the other hand, by their active movements, wandering disposition, quickness of hearing, and other minor characteristics, give evidence of greater intelligence. This I can state of them, however, as an impression only; for my efforts to prove them possessed of cunning were not successful. The purple salamander, it is true, fights when captured, curving its back, and snapping viciously. This no frog ever does. The common spotted triton (Diemyctelus) becomes quite tame when kept in an aquarium, and, as I found, is soon able to determine the difference between a fly held against the glass and one held over the water. I frequently held a fly against the glass, and very near the triton; but it took no notice of it, after one or two efforts to seize it, but would follow my hand, and, when the fly was held over the surface of the water, the triton promptly leaped at and seized it. This is, indeed, but meagre proof of intelligence, but seems to show, I think, that a salamander is more cunning than a frog.

My observations lead me to conclude, that the habits of an animal have much, if not all, to do with the intellectual capacity it possesses. Frogs, as a class, are not migratory. They frequent a given pond or stream; and, sustained by the insect-life that comes to them but is not sought, they pass an eventless life, trusting, as it were, to luck. Such an existence requires no intellectual exertion, and none is made. The salamanders, on the contrary, are far more wandering and active. They appear to be ever in search of food, and, when lying in wait for it, choose such positions as experience has taught them are best adapted for the purpose: at least, my studies of such specimens as I have kept in confinement lead me to believe so. Intellectually, therefore, the salamanders are in advance of the frogs; but the batrachians as a class, although higher in the scale of life than fishes, are, I believe, inferior to them in intelligence.

CHAS. C. ABBOTT, M.D.

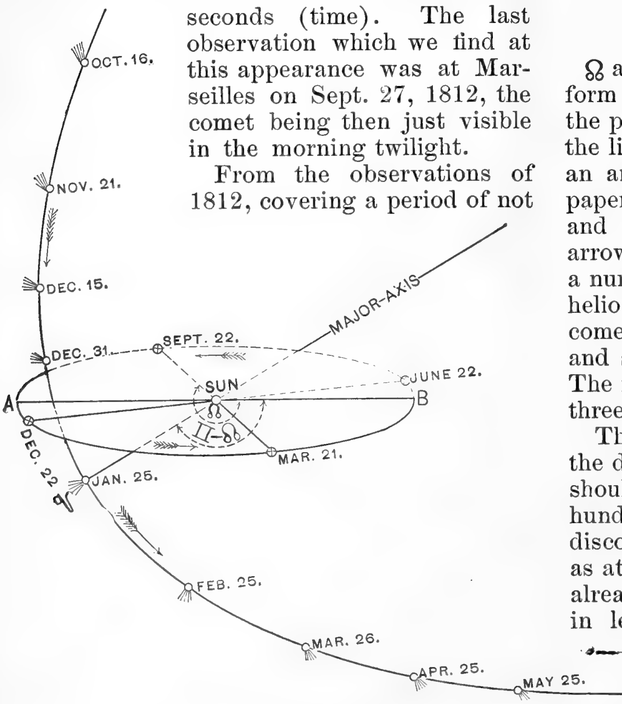
THE PONS-BROOKS COMET.

THE comet which is now being observed at its first predicted return was discovered by Pons, at Marseilles, two hours after midnight of July 20, 1812. Pons was at the time *concierge* at the Marseilles observatory, but afterwards became its director. He died in Florence, Oct. 14, 1831, at the age of seventy, having, between the years 1801 and 1827, discovered no less than thirty-seven comets; this one, according to Zach (*Monatl. corr.*, xxvi. 270), the sixteenth in ten years.

Pons describes the comet at the time of discovery as an irregular, nebulous mass, without coma or tail, and invisible to the naked eye. Having made sure, from the motion, that it was really a comet, he announced his discovery on July 22; and, from July 25 to Aug. 3, it was bright enough to be observed, at lower culmination, with the Marseilles in-

struments. The comet seems to have been discovered independently at Paris by Bouvard, who describes it thus: "Cette comète était très petite. Elle ne fut visible à la simple vue que pendant quelques jours. Le 18 août son noyau, assez brillant, était entouré d'une nébulosité qui offrait l'apparence d'une chevelure et d'une queue d'environ 2° de longueur." Bode reports the comet visible to the naked eye on Sept. 9, 1812, and on Sept. 14 he gives the tail as 1° long; while on the same date, at Seeberg, the tail is given as 2° 17′, and the diameter of the nucleus 5.4 seconds (time). The last observation which we find at this appearance was at Marseilles on Sept. 27, 1812, the comet being then just visible in the morning twilight.

From the observations of 1812, covering a period of not quite ten weeks, several orbits were computed, that of Encke assigning a period of 70.68 years. More recently Messrs. Schulhof and Bossert, from an exhaustive discussion of all the observations available (including some not known to Encke), predicted a return to perihelion about September, 1884, though they pointed out that in their period there was an uncertainty of ±5 years. The comet was actually found by Brooks (Phelps, N.Y.) on Sept. 1, 1883, some time before it had reached the sweeping ephemeris of Schulhof and Bossert; but its identity was soon established.



PATH OF PONS-BROOKS COMET.

The annexed diagram will assist in forming an idea of the path in which the comet is moving. The earth's orbit (the northern side uppermost) is shown orthographically projected upon the plane of the comet's orbit. The data necessary for defining the ellipse in which the comet moves are, the angle ☊ (254°), the longitude of the ascending node; the angle ☊ − ☊ (−161°), the difference between the longitude of the node and the longitude of perihelion (☊); the angle i, the inclination between the earth's orbit and that of the comet; q, the perihelion distance (0.775) expressed in units of the earth's distance from the sun; T, the date of perihelion passage; and e, the eccentricity (0.96), or ratio, —

$$\frac{\text{distance from centre to focus}}{\text{semi-axis major}}.$$

☊ and ☊ − ☊ are shown in the figure; and, to form the complete picture, we are to imagine the plane of the comet's orbit revolved about the line AB, the line of nodes, until it makes an angle of 74° (i) with the plane of the paper. The directions in which the comet and the earth are moving are indicated by arrows. The positions of the two bodies on a number of dates are also given. The perihelion is reached on Jan. 25, 1884, when the comet is seventy million miles from the sun, and sixty-eight million miles from the earth. The nearest approach to the earth, about fifty-three million miles, is upon Jan. 8, 1884.

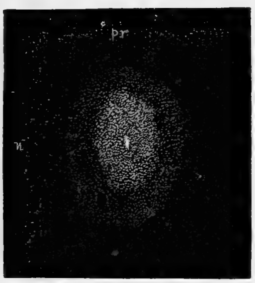
The brightness, as far as depending upon the distance from the sun and from the earth, should reach a maximum about Jan. 11, a hundred and forty-five times as bright as when discovered by Brooks, and five times as bright as at the time of Bode's observation, when, as already noted, the comet had a tail a degree in length. We might expect, then, that it would be visible to the naked eye from the middle of December to the middle of February, equalling, at its best, the brightness of a star of the third magnitude; but unusual and unexplained fluctuations in the brightness have been observed, which render these predictions a little untrustworthy. In the first week in December the comet passed within about seven degrees of the bright star α Lyrae, and continued its motion rapidly towards the south and east.

Since its discovery by Brooks, our visitor has behaved in a most peculiar manner as regards brightness. The theoretical change is given in Professor Boss's article in *Science*, ii. 449. On the following page we find observations made at Harvard college observatory on Sept. 21, 22, 23. The variability remarked at Harvard is confirmed by observations made at about the same time at Paris, Hamburg, and Dresden; so that we find a pretty well defined

maximum of from the seventh to the eighth magnitude, reached between Sept. 22 and 24, falling off suddenly on either side; for on Sept. 21 the comet was 'very faint,' with 'a slight condensation,' and on the 28th it was tenth to eleventh magnitude. Bigourdan says, "It had for some time a brilliancy thirty or forty times what might have been expected, — a fact difficult to explain on the theory that comets have no light of their own."

As regards any variability at its former appearance, the observations of 1812 are not sufficiently precise to furnish conclusive evidence.

A rough sketch of the comet, as seen with the 26-inch equatorial of the Naval observatory, Washington, was made on Sept. 26, 1883; and by permission of the superintendent of the observatory, Rear-Admiral R. W. Shufeldt, it is here given, with the observer's note. "Sept. 26.39, 1883; — observer, Winlock; —



PONS-BROOKS COMET, SEPT. 26, 1883.

26-inch equatorial, magnifying power 183. The comet appeared as an oval, nebulous mass, with a fairly well defined stellar nucleus, somewhat elongated in the *preceding following* direction, the nucleus being situated at about the centre of the nebulosity. The whole mass was some 6′ or 8′ in diameter."

The spectrum of the comet was examined by Konkoly,[1] Sept. 27, 1883. It consisted of three extremely faint bands, — the middle one brightest, the third (from the red end) next, and the one towards the red faintest. The bands ended in points, and were unequal in length. They sometimes lighted up for one or two seconds; and at these times they seemed to be much shorter than ordinarily, — a phenomenon quite new to the observer.

From the similarity of the orbits of the comets of 1812 and 1846, IV., Kirkwood has suggested (*Amer. journ. sc.*, 2d series, xlviii. 255) that they were doubtless members of a cometary system, and were brought into the solar system 695 years before the Christian era by the influence of Neptune. Schulhof and Bossert, in pointing out an error in Kirkwood's calculation, modifying somewhat his conclusion, say that the remarkable resemblance between the orbits of these comets indicates that there was originally some intimate connection between them. Indeed, these two comets, and the comets of 1815, 1847, V. (Brorsen), and 1852, IV. (Westphal), seem to belong to the same family.

As to the proper designation of this comet of Pons and of Brooks, authorities and precedents differ. In *The observatory* for November, 1883, Mr. W. T. Lynn writes, "I presume the designation Pons-Brooks's comet is understood to be only provisional. According to rule, it should be Pons's comet; . . . its permanent name must therefore be 'Pons's long-period comet,' or 'Pons's periodical comet of 1812.'" The shortest designation seems likely to prevail; and doubtless the comet will be known hereafter as the 'Pons-Brooks comet,' or perhaps simply as the 'Comet of 1812,' it being the only comet that was seen in that year.

W. C. WINLOCK.

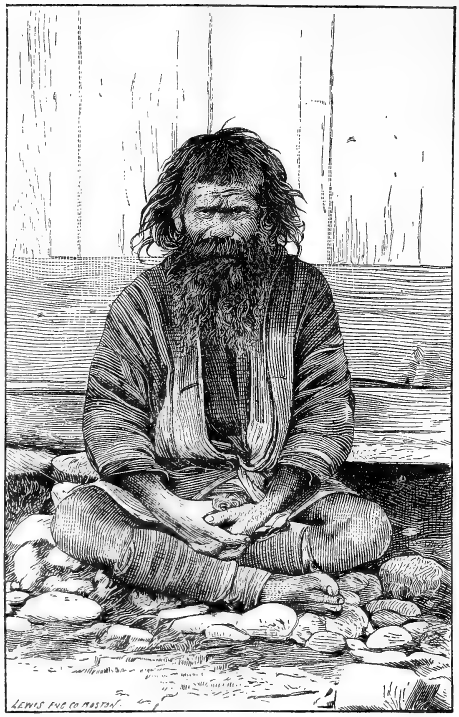
[1] *Astron. nachr.*, No. 2547. *The observatory*, November, 1883, 333.

THE AINOS OF YEZO.[1]

ALTHOUGH the literature relating to the Island of Yezo, and the Ainos, — the inhabitants of this island as well as the southern half of Saghalien (or Karafuto), the Kurile Islands, and the southern extremity of Kamtchatka, — has increased much in recent years, still a description of the same, based upon personal observation, may be of use in explaining the many contradictory reports and opinions of ethnologists. Two facts should be borne in mind, — first, that the Ainos are not, even in the most remote way, to be classed with the dark races; and, second, that they are in no way related with their southern neighbors, the Japanese. With regard to their color, I must remark, that I have not found the Ainos of either sex darker than many Europeans: indeed, it is not rare to find in southern and eastern Europe darker individuals than are to be seen among the aborigines of Yezo. The assertion that the Ainos are dark brown, or even black, is sometimes made by those who do not take into consideration the fact that superstition prevents them from washing, and that consequently their complexion appears at times much darker than it really is. The real color, which may be best seen to advantage among the Ainos living on the seashore, is a little lighter, and less reddish, than that of the Japanese. The development of hair is somewhat remarkable: in the case of the men it covers the entire body to about the extent seen in very hairy Europeans. The beard is luxuriant and beautiful: the women imitate it by tattooing. The curly or wavy

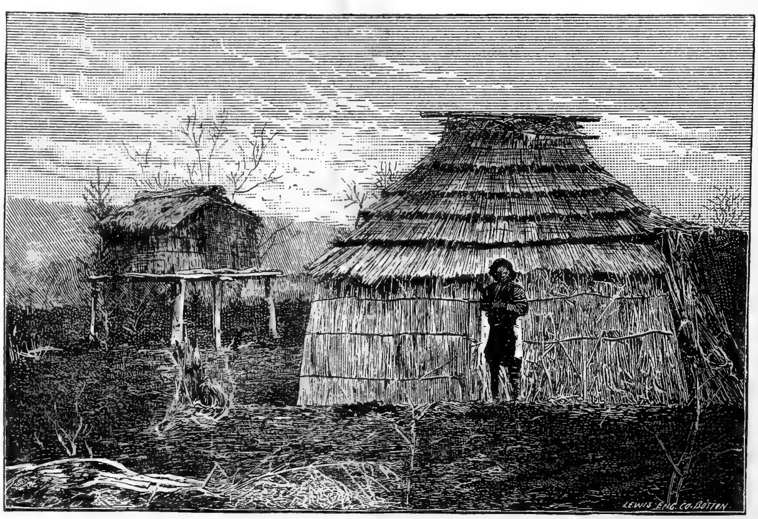
[1] By Professor BRAUNS of Halle. Translated from the memoirs of the Berlin anthropological society.

character of the hair of the head is quite striking. The physique is much better than that of the Japanese; the thigh is not so strikingly shortened; and the muscles are more strongly developed, while there is a weaker development of subcutaneous adipose tissue. The physiognomy and cranial conformation are also very different. The eyes are more deeply set than in the Japanese; and, as with us, they are shaded by heavy brows. The orbits, as shown by the skeleton of the face, are less high; and therefore the lids are horizontal, except in some hybrids. In contrast with the Japanese race, the forehead is straight; prognathism, when present, is very slight; and the nose and chin are generally well developed. The facial expression differs also from that of the Japanese: it indicates a certain fearlessness, joined with ingenuousness and a happy disposition. The intellectual characteristics correspond, as might be expected, to the impression produced by external features.



AN AINO MAN.

As has often been noted, the generous and respectful hospitality of the Ainos never fails to make a more favorable impression on the traveller than is received among the Japanese. In the southwestern parts of the island the character changes somewhat under the influence of the dominant race; and here hybrids are quite numerous. The latter fact has doubtless given rise to erroneous opinions as to the affinities of the two races; for no one would assert a relationship of language, except travellers who knew nothing of the language of either race, and who regarded the Japanese language, which is spoken fluently by the Ainos, as the vernacular of the Ainos. All those who (as Dawidoff, Klaproth, Dobrotworsky, Pfizmaier, v. Siebold, Scheube, Batchelor, Miss Bird) have prepared larger or smaller Aino vocabularies have escaped this error.



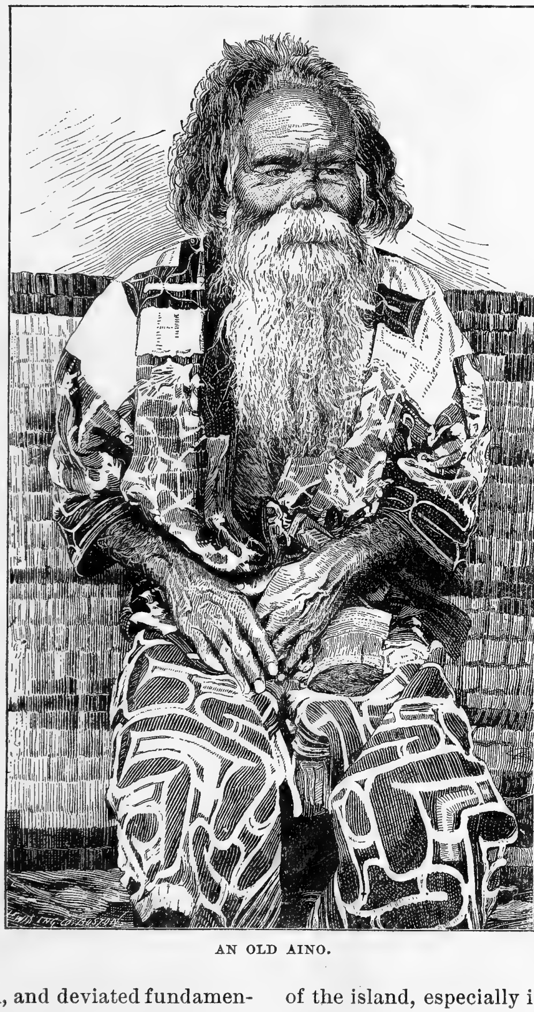
AINO HUT.

These observations were forced upon me on my first acquaintance with the Ainos in and around Sapporo, where I learned to know, also, the Ainos that were brought from Saghalien to Yezo at the time the former island was ceded to Russia. My conclusions were further supplemented and confirmed through a festival instituted by the government of Sapporo (July 9, 1881), in order to show me, as they said, the earlier conditions of the island, as well as the products of modern civilization.

At one end of a large hall, in which we were seated, were seen a number of Saghalien Ainos regaling themselves with saké (rice-wine) under the mellow radiance of oriental lamps. Upon a signal to begin, a young man arose, and led on the women to a round dance, while the older men remained seated. The women, with their faces turned toward the centre of the circle, alternately prostrated themselves and arose, at the same time festively moving onward in the circle. Picturesque as was their costume, consisting of long robes made from the bast of the elm, and metal girdles on which hung carved knife or sickle scabbards, this dance was

of inconsiderable interest, in comparison to the soft, melancholy, but melodious music, with its perfect time, which accompanied it. This singing would not have surprised me in the least in Norway, for example; but here it appeared in the most striking contrast with similar efforts of the Japanese, and indicated quite a different cast of mind.

In the vicinity of Sapporo was Juishikari, an Aino village of especial interest. It was here that I came to know the construction of their huts (great squares with smaller additions, all hung with rushes and reeds), many of their customs, their touching adhesion to their old nature-worship, their worship of the sun by the *Inawo* (a sacred staff frilled with shavings pendent from its upper end, and placed in the eastern window of the hut), and their fear of the dead. Their food consists mainly of millet and salted salmon.



AN OLD AINO.

The intelligence of the Ainos is by no means small. They learn the Japanese language very easily, accustom themselves very readily to all innovations which are not in conflict with their religious conceptions, occasionally make improvements, and are ready to answer questions in a precise manner. They never betray their age, and pretend not to know it. With this exception, I learned every thing I wished from them. I obtained, for example, a detailed account of their terms for different colors. After what I had seen, I was not surprised to find that these terms quite conformed to our own, and deviated fundamentally from those of the Japanese. The Japanese have only one word for *blue* and *green;* while the Ainos have distinct names for both colors, which often appear to be confounded when interpreted by the Japanese.

In Saru (or Sara) I had an opportunity to see all of an ancient state organization that has survived the introduction of a village government. Here I found the seat of the chief among the village elders, which was formerly located somewhat farther in the interior, at Biratori or Piratoru. The chief was regarded by the Ainos as a sort of king. Under Japanese domination his power and rank were lost.

The mode of travelling has been well described by Miss Bird. It is impossible to make any progress without horses; and these, although not of the meanest sort, are most shamefully abused by the Japanese. In this respect the Ainos generally prove useful and agreeable servants, but they are often the too subservient tools of their masters. However, I have never seen the Ainos abuse their horses, their only domestic animals, in the reckless and brutal manner observed among the Japanese: indeed, I have witnessed on many occasions quite the opposite mode of treatment.

In my journeys along the coast, I became convinced that the population of the Ainos had been under-estimated, just as that of the Japanese had been over-estimated. While the number of the latter is certainly less than a hundred thousand, instead of more, as officially reported, the number of the Ainos (said to be eighteen thousand) must be trebled in order to reach approximately accurate figures. The erroneous estimate of the Japanese government is explained by the fact that it takes no account of the large number of Aino villages on the large rivers of remote parts of the island, and particularly along the coast, but is based on the relation of the square surfaces of known and unknown parts. In some of the better known parts of the island, especially in the south-west, the Ainos have been completely dislodged; and in the mixed districts their number has also been much reduced.

From all these observations, as well as from the traditions of the Ainos, in which are ever-recurring laments for a better past, and from many peculiarities in their customs (e.g., loss of the use of really good weapons, the poisoning of the arrows and snares for beasts of the chase, particularly bears), we must conclude that the Ainos are to be classed with those peoples that have earlier been more richly supplied

with the implements of civilization, but have become degraded intellectually through isolation. Prehistoric discoveries, particularly those made in the region of Otaru, on the west coast of the island, favor this view. The pits found there for dwellings indicate that the Ainos came from the north to Yezo. The shell-heaps contain, besides very elegant potsherds, many stone implements, especially obsidian heads of lances and arrows, and ornaments of different kinds, as stone-beads and the like. In all these respects the shell-heaps are distinguished from those found throughout Japan, from latitude 39° north to the southernmost point of the coast of Kiushiu, within which limits the shell-heaps are destitute of ornaments, poor in stone implements, and entirely without obsidian. These facts point to a higher civilization of the Aino race, and at the same time refute the assumption that the Ainos formerly settled a large part of the main island (Nipon), — an assumption erroneously supposed by some to be supported by prehistoric discoveries. As there is no near relationship between the Ainos and the Giljaks of North Saghalien, who are less hairy, more prognathous, and more like the Tchuktchi race, we must assume that the Ainos were displaced by the Giljaks, and that their nearest relatives, judging from important analogies of language, and especially from their 'naturell,' are to be sought among the Kaoli of northern Corea (Oppert's Caucasian type of Koreans). The latter have symmetrical features and luxuriant beards, and are therefore called 'bearded barbarians' by the Japanese. They stand to the inhabitants of southern Corea in many respects as the Ainos to the Japanese. The Kaoli have had, to be sure, a history very different from that of the Ainos; for they became a civilized people, while the Ainos in the primeval forests of Yezo became more and more uncivilized. This fact is not opposed to the assumption of a kinship of the two races; and this assumption is supported not only by the particulars already alluded to, and the undeniable capacity of the Ainos for greater intellectual activity than they now exhibit, but also by the fact, that, notwithstanding the developed culture of the Coreans, certain things (e.g., the lance-shaped turrets on grave monuments) recur which remind one of Yezo. Besides, the traditions of the Kaoli, and certain names of places in the southern part of Amur (on the Sungari and its south-eastern tributaries), point to earlier dwelling-places of the race. From here the Ainos probably spread over the lower part of Amur and Saghalien. Other attempts to bring the Ainos and the North-Coreans into close relationship with other peoples are too hypothetical to require mention here. It is certainly to be hoped, but unfortunately it can hardly be expected, that the silent but eloquent appeal for friendly sympathy which the hearty greeting of the Ainos and the melancholy look given to strangers seem to make clear, may meet with some practical response: at all events, we should not withhold our most cordial good will from these sons of the primeval forests of our temperate zone, who are unquestionably the most peaceful and good-natured of all the so-called 'savages.'

THE HOT BLAST IN MAKING IRON.

At the last few meetings of the Iron and steel institute of Great Britain very important papers have been presented and discussed, showing the direction in which competition has brought about economy in iron-manufacture. These papers, notably those of Messrs. Cochrane, Hawdon, Bell, Cowper, and Howson, give to the technical reader a very good idea of the latest opinions of the foremost iron-makers of England.

The institute held its September meeting in Middlesborough, — the place in which it was organized fourteen years ago. This anniversary naturally led to some general reflections on the progress made in that time, which can be appreciated by the general public. The only drawback to the discussions was the absence, owing to illness, of Mr. I. Lowthian Bell, who has been present at all the previous meetings.

In 1828 Mr. J. B. Neilson patented a process for heating the air before it was blown into the blast-furnace, claiming that a gain in economy of working was the result. The idea was received with disbelief in most quarters. A little later Mr. Neilson proved conclusively to all that one hundred pounds of coal burned in heating the air for the blast were able to save three hundred to four hundred pounds of the fuel used within the furnace. The first step was made, and the iron-makers had to accept the consequences.

From this small beginning the tide of invention and enterprise went on, until the air used for blast was no longer heated by coal burned for the purpose, but by the combustion of what were formerly waste gases issuing from the top of the furnace. One improvement after another was introduced, until the temperature of the blast was raised to 900° F., and even to 1000° F. At this point it seemed that the metal pipes used in the stoves for heating had reached their limit of endurance; and a portion of the iron-making world made up their minds that greater heat than this could not be economically maintained, and that, even if the question of obtaining the heat was solved, there was still a balance of chemical reactions within the furnace which would prevent the greater heat from being advantageous.

Meanwhile, by the use of the Siemens regenerator principle, two different inventors, Cowper and Whitwell, each manufactured stoves which contained fire-brick chambers, within which the waste gases burned for a period, until the fire-bricks were at a red heat. The gases were then turned off to the alternate stove, and the air for the blast-furnace was driven in through the heated stove until the other one had become sufficiently heated. The interchange was again made, and so on. These various devices have resulted in the production of a blast of air for the furnace heated up to 1600° F., or even to 1700° F.

Now let us see what has been the result of this change. The blast-furnaces of 1869 produced, on an average, a little over 180 tons of iron per week. To-

day they produce, on an average, upwards of 300 tons per week, in some cases 800 or 900 (and in one of the Pittsburg furnaces the enormous output of 1,800 tons has been reached). Mr. Charles Cochrane, an advocate of the hottest hot blast, stated, that, at the works at Ormsby, they began in 1855 with a furnace of 7,000 cubic feet capacity, and with a temperature of air between that of molten lead and molten zinc, using 39.64 cwts. of coke to the ton of pig. In 1857 they used 33.87 cwts.; in 1867 it was only 29.66; in 1877 it had become reduced to 22.64; and in 1882, 21.18 cwts. was the average for all furnaces, small and large, while the larger furnace of 34,000 cubic feet capacity worked the whole year through on 19.38 cwts. per ton of pig. Hence from 1855 to 1883 the saving was 20.34 cwts. of coke per ton of iron; and, in Mr. Cochrane's opinion, fully half this saving was due to the use of the Cowper fire-brick stoves.

Mr. Cochrane has recounted some of the theoretical calculations that have been made. In 1879 he ventured to predict that a ton of iron could be made with 17.90 cwts. In 1881 he had made iron with 18.40 cwts. Another iron-master stated that a furnace has run for eight weeks on less than 18 cwts.

Mr. Hawdon claims that heating the blast from 990° F. to 1400° F. resulted in a saving of 1.5 cwts. of coke to the ton of iron, and that a further heating to 1550° F. was followed by a total saving of 2.5 cwts., bringing the coke down to 21.3 cwts.

In the discussions which took place at the meetings referred to, the prominent iron-manufacturers generally took the ground that the hotter the blast the better the result, up to the temperature of melting iron. Mr. I. Lowthian Bell, however, dissents from this view, and thinks, that, in real ultimate economy, 1000° F. will prove to be about the limit of heat for the blast which it is worth while to strive for.

R. H. RICHARDS.

MODERN PHYSIOLOGICAL LABORATORIES: WHAT THEY ARE AND WHY THEY ARE.[1] — I.

A LITTLE more than seven years ago I announced from this platform that the old biological laboratory was ready for use, — that set of rooms in the third story of this building, which, inconvenient in many respects as they were, will, I trust, always be remembered by some of us with affection, and mayhap with a little pride.

This night on which we have met to celebrate the completion of the new laboratory is, however, an occasion for looking forward rather than backward. But before proceeding to speak in detail of the new building, I feel sure I do but what every one of the members of the biological department present would think me remiss to omit, in pausing a moment to express our gratitude to those to whom we owe it, — first to our founder, Johns Hopkins, for his munificence; and next to his trustees. Probably very few present realize how much time and thought the trustees spent on the building before a stone of its foundation was laid, and during its erection. No one but myself knows how often I have been put in good heart by the cheering words, "Well, Dr. Martin, let us get it right when we are about it." In this connection I cannot refrain from saying, that, though we owe all so much, we owe a special debt of gratitude to Mr. Hall Pleasants, the chairman of the building committee. Throughout the whole summer there was hardly a morning on which he did not visit the building, and that not merely for a glance, but far more often to spend an hour or two hours about it, and make sure that all was going right.

[1] An address delivered on the occasion of the formal opening of the new biological laboratory of the Johns Hopkins university, Jan. 2, 1884. By H. NEWELL MARTIN, M.D., Dr. Sc., M.A., professor of biology in the university.

The material result of this liberality, forethought, supervision, and care, is that stately building on the top of the hill. Handsome though not ostentatious, comfortable but not luxurious, pleasant to work in without unnecessary finery, it stands there, for its purpose unrivalled in the United States, and not surpassed in the world.

Substantial, solid, well thought out, suited to its ends, and with no frippery about it, it is now for us to see that our work agrees in character with the building.

There are many here to-night, who, not being biologists, may desire to know what such laboratories are for, and why there is any need of them. I shall perhaps best begin my attempt to answer these questions by stating briefly what our own laboratory is.

It is a building constructed primarily to afford facilities for instruction and research in physiology; and, secondarily, similar opportunities in allied sciences, as comparative anatomy and botany, some training in which is essential (and the more the better) to every one who would attain any real knowledge of physiology. As so many distinct branches of biological science are pursued in it, we call it in general the biological laboratory; but it is a biological laboratory deliberately planned that physiology in it shall be queen, and the rest her handmaids. If, therefore, you visit the building prepared to see a great zoölogical museum or an extensive herbarium, you will be disappointed. I do not underrate, and no one connected with this university can, — bearing in mind the brilliant anatomical researches of Dr. Brooks and others, made among us, — the claims of morphology; and in time I trust we may see a sister building specially designed for study of the structure, forms, and development of plants and animals. But one or the other had to be first chosen, unless we were to do two things imperfectly instead of one well, and there were strong reasons for selecting physiology. In the first place, I think even the morphologists will admit that hitherto, and especially in the United States, they have had rather more than their fair share; innumerable museums and many laboratories have been built for their use; while physiology, if she got any thing, was usually allotted some out-of-the-way room in an entirely unsuitable building, if

no one else wanted it, and was very glad to get even that. A second and still stronger reason is, that as medicine is slowly passing out of the regions of empiricism and rule-of-thumb treatment, or mal-treatment, it has become evident that sound physiology is its foundation; and this university will at no distant day have a medical school connected with it.

As you walk presently through the rooms of the new building, and see the abundance of instruments of precision for teaching and research — the batteries, galvanometers, induction-coils, and spectroscopes; the balances, reagents, and other appliances of a chemical laboratory; the microscope for every student; the library of biological books and journals; the photographic appliances; the workshop for the construction and repair of instruments — when you see these things, it may interest you to recall that sixty years ago there was not a single public physiological laboratory in the world; nor was there then, even in any medical school, a special professor of physiology. So late as 1856 Johannes Müller taught in Berlin, human anatomy, comparative anatomy, pathological anatomy, physiology, and embryology.

DuBois-Reymond, now himself professor in Berlin, has graphically described the difficulties of the earnest student of physiology, when he attended Müller's lectures in 1840.[1]

"We were shown (he says) a few freshly prepared microscopic specimens (the art of putting up permanent preparations being still unknown), and the circulation of the blood in the frog's web." So much for the histological side.

"We were also shown the experiment of filtering frog's blood to get a colorless clot, an experiment on the roots of the spinal nerves, some reflex movements in a frog, and that opium-poisoning was not conducted along the nerves. There were some better experiments on the physiology of voice, — a subject on which Müller had recently been working; and there was finally a demonstration of the effect upon respiration of dividing the pneumogastric nerves."

In all, you see six experiments, or sets of experiments, in the whole course, in addition to the exhibition of some microscope slides; and all these mere demonstrations. It was hardly thought of, that a student should use a microscope, or make an experiment, himself. If he desired to do so, the difficulties in his way were such as but few overcame.

"He must experiment in his lodgings, where on account of his frogs he usually got into trouble with the landlady, and where many researches were impossible — there were no trained assistants to guide him — no public physiological library — no collection of apparatus. We had to roll our own coils, solder our own galvanic elements, make even our own rubber tubing, for at that time it was not an article of commerce. We sawed, planed and drilled — we filed, turned, and polished. If through the kindness of a teacher a piece of apparatus was lent to us, how we made the most of it — how we studied its idiosyncrasies — above all, how we kept it clean!"

Of course certain men, the men who were born to become physiologists, and not mere attendants on lectures on physiology, surmounted these difficulties.

[1] Emil DuBois-Reymond. *Der physiologische unterricht, sonst und jetzt.* Berlin, 1878. The quotations from this pamphlet, while giving, I trust, a true idea of the substance of DuBois-Reymond's statements, have been curtailed, and are not to be regarded as literal full translations of the original. — H. N. M.

One has only to recall the names of DuBois-Reymond himself, and of such of his contemporaries as Brücke, Helmholtz, Ludwig, Vierordt, Donders, and Claude Bernard, to realize that fact; and undoubtedly there was a good side to it all. Triflers, at any rate, were eliminated; and the class of individuals was unknown who sometimes turn up at modern laboratories (and, judging from a good deal of current physiological literature, sometimes get admitted to them) with a burning desire to undertake forthwith a complicated research, though they would hardly know an ordinary physiological instrument if shown to them, much less how to handle it. They never can wait: they must begin the next morning, believing, I presume, that modern laboratories are stocked with automatic apparatus, — some sort of physiological sausage-machines, in which you put an animal at one end, turn the handle, and get a valuable discovery out at the other.

With one exception, Berlin was not in 1840 worse off than other German universities, so far as facilities for physiological study were concerned, and certainly better off than any university in England or the United States. The exception was in Breslau, where the celebrated Purkinje, single-handed, had founded a physiological institute. It has usually been supposed that in this he followed the example given by Liebig, who founded at Giessen the first public chemical laboratory; but this, *pace* my colleague Professor Remsen, can hardly have been the case. It is to Purkinje that the honor belongs of founding the first public laboratory. Liebig undoubtedly conceived the plan when working in Paris in Gey Lussac's private laboratory, but it was not until 1826 that he began to put it into execution; and at that date Purkinje had already, largely at his own cost, started a physiological laboratory at Breslau, open to students, — on a very small scale, it is true, but still the germ of all those great laboratories of physics, chemistry, and biology, which are now found in every civilized country, and to which, more than to any thing else, modern science owes its rapid progress. Of these there must be at least forty now organized for physiological work; and almost every year sees an increase in their number. How has this come about in the fifty odd years which have passed since the origination of Purkinje's ill-equipped and little known workrooms?

First and foremost, because of the improvement in philosophy which took place as men began to break loose from the trammels of Greek and mediaeval metaphysics, and to realize that a process is not explained by the arbitrary assumption of some hypothetical cause invented to account for it. So long as the phenomena exhibited by living things were regarded, not as manifestations of the properties of the kind of matter of which they were composed, but as mere exhibitions of the activity of an extrinsic independent entity, — a pneuma, anima, vital spirit, or vital principle which had temporarily taken up its residence in the body of an animal, but had no more essential connection with that body than a tenant with the house in which he lives, — there was no need for physiological laboratories. Dissection of the dead body might, indeed, be interesting as making known

the sort of machine through which the vital force worked, — just as some people find it amusing to visit the former abode of a great author, and see his library and writing-table and inkstand; and there might be discussions as to the locality of the body in which this vital force resided; to carry out our simile, as to what was its favorite armchair. Various guessers placed it in the heart, the lungs, the blood, the brain, and so forth. Paracelsus, with more show of reason, located it in close connection with the stomach, on the top of which he supposed there was seated a chief vital spirit, Archaeus, who superintended digestion. It is mainly to Descartes,[1] who lived in the earlier half of the seventeenth century, that physiology owes the impulse which set it free from such will-o'-the-wisps. Putting aside all consciousness as the function of the soul, he maintained that all other vital phenomena were due to properties of the material of which the body is composed; and that death was not due to any defect of the soul, but to some important alteration or degeneration in some part or parts of the body.

The influence of Descartes, and in the same half-century the demonstration of the circulation of the blood by Harvey, gave a great impulse to experimental physiology. Both Harvey and Descartes, however, still believed in a special locally placed vital spirit or vital *force*, which animated the whole bodily frame as the engine in a great factory moves all the machinery in it. What a muscle did, or a gland did, depended on the structure and properties of the muscle or gland; but the work-power was derived from a force outside those organs, — on vital spirits supplied from the brain along the nerves, or carried to every part in the blood. As the pattern of a carpet will depend on the structure and arrangement of the loom, — which loom, however, is worked by a distant steam-engine, — so the results of muscular or glandular activity were believed to be determined by the structure of muscle and gland; but the moving-force came from some other part of the body.

The next essential advance was made by Haller, about the middle of the eighteenth century. He demonstrated that the contracting-power of a muscle did not depend on vital spirits carried to it in nerve or blood, but on properties of the muscle itself. Others had guessed, Haller proved, that the body of one of the higher animals is not a collection of machines worked by a central motor, but a collection of machines each of which in itself is both steam-engine and loom; leaving aside, of course, certain of the purely mechanical supporting and protecting apparatuses of the skeleton. This was the death-blow of the 'vital force' doctrine. Extensions of Haller's method showed that it was possible to destroy the brain and spinal cord of an animal, and separate its muscles, its heart, its nerves, its glands, and yet keep all these isolated organs working as in life for many hours. The life of an animal could be no longer regarded as an entity residing in one region of the body, from which it animated the rest; and the word gradually became simply a convenient phrase for expressing the totality or *resultant* of the lives of the individual organs. Physiologists began to see that they had nothing to do with seeking a vital force, or with essences or absolutes; that their business was to study the phenomena exhibited by living things, and leave the noumena, if there were such, to amuse metaphysicians. Physiology thenceforth became more and more a study of the mechanics, physics, and chemistry of living organisms and parts of organisms.

[1] See Huxley: *The connection of the biological sciences with medicine* (*The lancet*, Aug. 13, 1881).

Progress at first was necessarily very slow; physics and chemistry, as we now know them, did not exist; galvanism was not discovered; osmosis was unknown; the conservation of energy was undreamed of; while modern chemistry did not take its rise until the discovery of oxygen by Priestly, and the extension and application of that discovery by Lavoisier towards the close of the last century. Physiology had to wait then, as now, for its advance upon the development of the sciences, dealing with simpler forms of matter than those found in living things. But little by little, step after step, so many once mysterious vital processes have been explained as merely special illustrations of general, physical, and chemical laws, that now the physiologist scans each advance in these sciences in full confidence that it will enable him to add another to the phenomena of living bodies, which are in ultimate analysis not peculiar or 'vital,' but simply physico-chemical. Apart from the phenomena of mind, whose mysterious connection with forms of matter he can never hope to explain, if a modern physiologist were asked what is the object of his science, he would answer, "not the discovery or the localization of a vital force, but the study of the quantity of oxidizable food taken into the stomach, and the quantity of oxygen absorbed in the lungs; the calculation of the energy or force liberated by the combination of the food and oxygen; and observation of the way in which that force has been expended, and the means by which its distribution may be influenced."

Once it was recognized that at least the great majority of physiological problems were problems admitting of experimental investigation, the necessity for special collections of apparatus suitable for experiment on living plants and animals, and for affording students an opportunity to study the play of forces in living organisms, had not long to wait for recognition. Physiological laboratories were organized at first in such rooms as could be spared in buildings constructed for other purposes; later, in structures built for this special end. The first laboratory specially erected for physiological work was built for Vierordt, in Tübingen, less than twenty years ago. So far as I know, our own is the first such building in the United States.

There is still another reason which has combined with the recognition of the independence of physiology as a science to make the modern laboratory, open to all properly prepared students, a possibility; and physiology owes it to this country. I do not forget how Brown-Sequard in Philadelphia clinched and completed Bernard's great discovery of the vaso-motor

nerves; nor the researches of Weir Mitchell on the functions of nerve-centres, and the action of snake-poisons; nor, in later years, the researches of Wood on the physiology of fever; and on various subjects by Bowditch, Arnold, Flint, Minot, Sewall, Ott, Chittenden, Prudden, Keyt, and others. But speaking with all the diffidence which one, who, at least by birth, is a foreigner, must feel in expressing such an opinion, I say, that considering the accumulated wealth of this country, the energy which throbs through it, and the number of its medical schools, it has not done its fair share in advancing physiological knowledge, *but for one thing*, which makes the world its debtor. I mean the discovery of anaesthetics. When Morton, in 1846, demonstrated in the Massachusetts general hospital that the inhalation of ether could produce complete insensibility to pain, he laid the foundation-stone of our laboratory, and of many others. No doubt the men whose instincts led them to physiological research, and who realized that by the infliction of temporary pain on a few of the lower animals they were discovering truths which would lead to alleviation of suffering, and prolongation of life, not only in countless generations of such animals themselves, but in men and women to the end of time, would have tried to do their work in any case. But the men who can steel their hearts to inflict present pain for a future greater gain are few in number. The discovery of anaesthetics has not only led to ten physiological experimenters for each one who would have worked without them, but by making it possible to introduce into the regular course of physiological teaching, demonstrations and experiments on living animals, without shocking the moral sense of students or of the community at large, has contributed incalculably to the progress of physiology.

On the occasion of the opening of the old laboratory I used these words:[1] —

"Physiology is concerned with the phenomena going on in living things, and vital phenomena cannot be observed in dead bodies; and from what I have said you will have gathered that I intend to employ vivisections in teaching. I want, however, to say, once for all, that here, for teaching purposes, no painful experiment will be performed. Fortunately the vast majority of physiological experiments can nowadays be performed without the infliction of pain, either by the administration of some of the many anaesthetics known, or by previous removal of parts of the central nervous system; and such experiments only will be used here for teaching. With regard to physiological research, the case is different. Happily here, too, the number of necessarily painful experiments is very small indeed; but in any case where the furtherance of physiological knowledge is at stake — where the progress of that science is concerned, on which all medicine is based, so far as it is not a mere empiricism — I cannot doubt that we have a right to inflict suffering upon the lower animals, always provided that it be reduced to the minimum possible, and that none but competent persons be allowed to undertake such experiments."

Those words were a declaration of principle and a pledge given to this community, in which I was about to commence my work. That the work has been carried on for seven years among you, without a murmur of objection reaching my ears, is sufficient proof that Baltimore assents to the principle; and, gratifying as the building of our new laboratory is to me from many points of view, there is none so grateful as its witness, that, in the opinion of our trustees and of my fellow-citizens, I have carried out my pledge. There has been no hole-and-corner secrecy about the matter: the students in the laboratory have been no clique living isolated in a college-building, but either your own sons, or boarders scattered among dozens of families in this city; and no room in the laboratory has ever been closed to any student: what we have done has been open to all who cared to know. On this occasion, when we formally make a fresh start, I desire to re-assert the principle, and repeat the pledge.

[1] *Pop. sc. monthly*, November, 1876.

(To be concluded.)

BERTHELOT'S EXPLOSIVE MATERIALS.

Explosive materials, a series of lectures delivered by M. P. E. BERTHELOT; *translated by* MARCUS BENJAMIN. *A short historical sketch of gunpowder, translated from the German of* KARL BRAUN *by* Lieut. JOHN P. WISSER, U.S.A. *A bibliography of works on explosives; reprinted from Van Nostrand's magazine*, No. 70. N.Y., *Van Nostrand*, 1883. (Van Nostrand's science series.) 180 p. 24°.

THE lectures of Berthelot, which form the more important part of this collection, are devoted to a popular exposition and amplification of the theories which he has from time to time advanced, concerning the constitution and mode of action of explosive substances. The principal topics treated are, the force of explosives; the origin, duration, and speed of propagation of the explosive reactions; inflammation and detonation as modes of inducing explosions; and explosions by influence.

The force of an explosive may be understood in two ways: it may be considered either as the pressure developed or as the work accomplished. The pressure depends principally upon the nature of the gases formed, their volume, and their temperature. The work, on the other hand, is principally dependent upon the amount of heat given off in consequence of the chemical decomposition. In practice, as, for instance, in guns, the transformation of this heat into useful work is never complete, since heat is absorbed by the gun, gases, and projectile, and a portion of the work produced is lost in moving the gases and air projected. Taking all these facts into consideration, it has yet been difficult to explain the great differences which result from the different methods employed for inducing explosions. Berthelot holds that this diversity depends upon the rapidity with which the explosive reaction propagates itself, and the more or less intense pressures which result from it, and he illustrates it as follows: —

Let the case be the simplest one, such as an explosion caused by the fall of a weight from a certain height. At first one would suppose the effects observed to be due to the heat developed by the pressure of the suddenly arrested weight. But calculation shows that the arresting of a weight of several kilograms, falling .25 to .50 of a metre, would not be capable of raising the temperature of the explosive mass more than a fraction of a degree, if the resulting heat were dispersed uniformly throughout the entire mass: while for a body such as nitroglycerine, for instance, it is necessary to heat it to 190° to induce explosion.

It is by another process that the mechanical energy of the weight, which is transformed into heat, becomes the originator of the observed effects. It is sufficient to assume, that, as the pressures which arise from the shock exerted on the surface of the nitroglycerine are too rapid to become uniformly dispersed throughout the entire mass, the transformation takes place locally among the layers first reached by the shock. If it is sufficiently violent, they may thus be rapidly heated to the necessary temperature; and they will be immediately decomposed, and produce a large quantity of gas. This production of gas is in its turn so violent that the shocking body has not time to displace itself; and the sudden expansion of the gases of explosion produces a new shock, probably more violent than the first, on the layer situated below. The mechanical energy of this shock is changed into heat in the layers which it reaches, and produces an explosion; and this alternation between a shock developing mechanical energy which changes into heat, and a production of heat which elevates the temperature of the layers up to the degree necessary for a new explosion capable of reproducing the shock, propagates the reaction, molecule by molecule, through the entire mass. The propagation of the deflagration takes place in this way in consequence of phenomena comparable to those which produce a sonorous wave; that is to say, by producing a real explosion which advances with a rapidity incomparably greater than that of a simple burning provoked by the contact of a body in ignition, and operating under conditions where the gases expand freely in proportion to their production.

The reaction started by the first shock in a given explosive material is propagated with a rapidity which depends upon the intensity of the first shock; and this intensity may vary considerably, according to the method by which it is produced. Marcel Duprez has shown that the effect of a blow from a hammer may vary in duration from the hundredth to the ten-thousandth of a second, according as one strikes with a hammer having a flexible handle or with a block of steel. From this it follows that the explosion of a solid or liquid mass may develop itself according to an infinite number of different laws, each one of which is determined, all other things being equal, by the original impulse. The more violent the initial shock, the greater will the resulting violence of the decomposition be, and the greater will be the pressures which are exerted during the entire course of this decomposition. One and the same explosive substance may hence produce very different effects, according to the method of ignition.

Among these methods of ignition, by far the most curious and inexplicable is the determining of the explosion of one mass by the explosion of another mass near by, but not in contact with it, which is termed by Berthelot 'explosion by influence.' Abel has offered his theory of *synchronous vibrations* to explain this phenomenon, and the theory seemed to be confirmed by the interesting experiments of Champion and Pellet; but Berthelot regards them as inconclusive, or else directly opposed to Abel's theory, and he offers a theory of his own, which is but an expansion of that of shocks explained above.

Working, as Berthelot is, under the direct auspices of the French government, he has had the best of facilities for the study of explosive substances and the phenomena of explosions; and no one has probably engaged in a more critical or extended physical and chemical examination of these bodies, and hence he speaks with authority. Yet some of his theories have failed to find general acceptance, especially that concerning the influence of dissociation upon the force of explosives; and it is noticeable that this theory finds no place in these lectures.

Karl Braun's sketch is bright and entertaining but iconoclastic, and, while wresting the honor of the discovery of gunpowder from Berthold Schwartz, intimates that the knowledge of its manufacture was brought from the orient to Augsburg in 1353 by a Greek Jew named Typsiles.

Of the 'Bibliography of explosives' the best that can be said is, that it is an unsystematized collection of titles, that it is filled with errors of the grossest kind, and that it is unworthy of both compiler and publisher. In fact, it must be said the book throughout is marred by printers' errors.

HOUSTON'S ELEMENTS OF CHEMISTRY.

The elements of chemistry; for the use of schools, academies and colleges. By EDWIN J. HOUSTON. Philadelphia, *Eldredge*, 1883. 444 p., illustr. 8°.

HOUSTON'S 'Elements of chemistry' is a brief compilation of the latest facts in regard to the science, arranged for the use of schools, academies, and colleges. Its use will be confined to the first named, or at least to institutions where the rudiments of chemistry are taught. The work is divided into three parts, — theoretical, descriptive or experimental, and organic, — and the arrangement is in most respects good. In the first part the fundamental laws are clearly and concisely stated, and present the subject in a form as well adapted to beginners as we have seen in any text-book. A short description of the different systems of crystallography concludes this portion. In the descriptive part the elements are discussed under the head of non-metals and metals in an order based upon their quantivalence; but the division of the metals into perissad and artiad is not one which most text-books follow. A brief outline is given, in the seventy-five pages of the third part, of the chemistry of the carbon compounds; and the author has succeeded in condensing into this space many important facts; there are, however, several erroneous statements and a general lack of completeness. The division of the carbon compounds into single link, double link, etc., is simply investing an old classification with a new name, and there is no gain in point of clearness.

A large portion of the book, nearly one-fourth, is repetition in the form of a syllabus and questions for review, at the end of each chapter, and, at the close of the book, questions for examination. This seems to be for the purpose of aid, in case the teacher should have had insufficient training in the subject. Indeed, so great is the help afforded, that with it any one with little or no knowledge of chemistry could assume the instruction of a class. We cannot but deplore the introduction of such a system of teaching at a time when it is all-important that chemistry should be scientifically taught in our elementary schools. Instruction in chemistry, to be thorough, should depend upon the teacher, and not upon the text-book. Only a good instructor can impress upon a beginner the necessity for observation, which is the prime requisite for successful work; and a text-book intended to be crammed tends to destroy the sense of observation. The space devoted to this system could have been profitably devoted to increasing the number of experiments and illustrations of experiments; which last are few and illy executed, and often do not show the best method of conducting the experiment. We object to the use of the Fahrenheit scale and English measures as causing a needless confusion, inasmuch as the centigrade scale and metric system are the accepted scientific notation.

BESANT'S HYDROMECHANICS.

A treatise on hydromechanics. Part i., hydrostatics. By W. H. BESANT, F.R.S., mathematical lecturer of St. John's college, Cambridge. 4th ed. *Deighton Bell & Co.*, 1883. 288 p. 8°.

THIS is "a reproduction, with considerable alterations and additions, of the first part of a treatise on hydrostatics and hydrokinetics, the third edition of which was published in 1877," and is intended as a text-book upon this subject, for those preparing for the mathematical tripos examinations at Cambridge, England. The principal heads treated are, the general conditions of fluid equilibrium; surfaces ot equal pressure; resultant pressures; the equilibrium, stability, and oscillations of a floating body (metacenter); the pressure of the atmosphere; the tension of flexible surfaces, and their relation to capillary phenomena; and, finally, the figure of equilibrium of a mass of rotating fluid, acted on by the mutual attraction of its parts. This work requires, as do most of the Cambridge mathematical text-books, that the reader shall have perfect facility in the employment of the differential and integral calculus. There is a plentiful list of examples, selected from previous examination papers, at the end of each chapter. It is perhaps superfluous to speak of the important place which the subject of hydromechanics has occupied in modern mathematical physics since the labors of Helmholtz, Maxwell, and Thomson, in reducing the mathematical treatment of electricity and magnetism to that of the motion of incompressible fluids. This volume is put forth as an introduction to the discussion of fluid motion or hydrokinetics, of which the elements will be given in part ii., which the author hopes to have in readiness early in 1884.

It is a matter of great regret that the state of mathematical training among our colleges is of such elementary character, that there are comparatively few of them where the excellent text-books of this grade can be profitably used by the undergraduates.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American philosophical society.

The Proceedings of the society, vol. xxi., No. 114, from April to December, 1883, to be distributed to the members and correspondents of the society in January, contains: 1. A memoir on the migration of the Tutelo tribe of Indians, by Horatio Hale (with a map); 2. Medieval sermon-books, etc., by Prof. I. F. Crane of Cornell university; 3. The latitude of Haverford college, by Isaac Sharpless; 4. A crinoid with movable spines, by H. S. Williams (with a plate); 5. The *rôle* of parasitic photophytes, by W. N. Lockington; 6. The reversion of series, and its application to the solution of numerical equations, by J. G. Hagen, S.J.; 7. The conversion of chlorine into hydrochloric acid in the deposition of gold from its solutions by charcoal; 8. A brief account of the more important public collections of American archeology in the United States, by Henry Phillips, jun.; 9. Photodynamic notes, No. viii., by Pliny E. Chase; 10. Introduction to a study of the North-American Noctuidae, by A. R. Grote; 11. Revision of the Lysiopetalidae, by A. S. Packard, jun.; 12. The Perry county fault, by E. W. Claypole; 13. Seeds sprouting in ice, by Joseph Lesley; 14. A relic of the native flora of Pennsylvania, by E. W. Claypole; 15. The Portage rocks in Perry county, by the same; 16. The genus Rensselaeria, by the same; 17. A large Catskill crustacean, by the same (with a plate); 18. Obituary notice of Henry Seybert, by Monclure Robinson; 19. The zone of asteroids and ring of Saturn, by Daniel Kirkwood; 20. Obituary notice of Dr. John F. Meigs, by Dr. William Pepper; 21. Kintze's fire-damp indicator, by Charles A. Ashburner; 22. Obituary notice of Oswald Heer, by Leo Lesquereux; 23. Obituary notice of Dr. John L. LeConte, by Dr. George H. Horn; 24. Aerial ships, by Russell Thayer, C.E.; 25. Section of Chemung rocks at Le Roy, Bradford county, Penn., by A. T. Lilley; 26. Distribution of Loup Fork formation in New Mexico, by E. D. Cope; 27. Second addition to the knowledge of the Puerco epoch, by the same; 28. The trituberculate type of tooth in the mammalia, by the same; 29. Delaney's synchronous multiplex telegraph, by Edwin J. Houston; 30. The microscopic examination of timber with regard to its strength, by Frank M. Day (with a plate). Several papers requiring illustrations are left over to be published in No. 115, as it is the custom of the society to publish its two annual numbers of its proceedings as nearly on the 1st of January and June as possible. No. 114 includes pp. 1 to 350 of the current vol. xxi.

The society has also published, as part i. of vol. xvi. of its transactions, a Dictionary of Egyptian hieroglyphics, by Edward Y. McCauley, U.S.N. (240 p., 4°), printed from relief-plates photographed from Commodore McCauley's manuscript.

The society is printing the last pages of its library catalogue, the fourth and last part of which will be published in February or March. The whole catalogue (three parts of which have been distributed in previous years) will make about fifteen hundred pages octavo. There will be subsequently published an alphabetical index of author's names, and a supplement of books received since a certain date.

The society is also printing, as a volume of about five hundred pages octavo, a succinct transcript of its minutes from 1744 to 1837, made by the secretary in 1882. Its proceedings were first published in 1838, and subsequently in one series up to the current No. 114. The possible destruction of the minute-books, by fire or otherwise, has always been a cause of anxiety. When this volume from 1744 to 1837 is printed, a complete history of the society will be secured. Already proof-reading has reached p. 288 (minutes of 1800), and the volume will probably be published in May next.

Cincinnati society of natural history.

Jan. 8. — Dr. Walter A. Dun read a paper on some recent explorations of mounds in the Scioto valley. The paper gave a detailed description of the mound, a large one, its dimensions being thirty-three feet in height, and a hundred and fifteen feet in diameter. The shaft sunk from the top showed several intrusive burials, and that the mound was constructed of successive layers of sand and clay. At the depth of twenty-five feet a vault constructed of logs was found, in which was a large quantity of root-like fibres, with a skeleton in a fair state of preservation. The skull was saved almost entire, and was described in detail by the doctor, who found it to compare closely with the figures of mound-builder skulls in Squier and Davis's 'Monuments,' and Morton's 'Crania americana.' A number of flint arrow-points, shell beads, and a small octagonal piece of sandstone, were also found in the 'vault.' The vault was eight feet high, five feet and a half long, and four feet wide.

The discovery of an authentic mound-builder's skull was regarded as important, and worthy of record. Dr. Dun also read a detailed description of the teeth and jaw of the skull, prepared at his request by Dr. E. G. Betty. Mr. Joseph F. James remarked that a skull found near Memphis, Tenn., associated with some earthen pots bearing dates of 1654–1708, showed the same remarkable flattening of the occipital region shown in Dr. Dun's specimen.

Mr. J. R. Skinner said that he had lately observed that the symbol of the Aztec god, Itzcoatl (), was the same as a marking upon what is known as the Richardson tablet from Wilmington, O.

Society of arts, Massachusetts institute of technology.

Dec. 27. — Mr. John Ritchie, jun., exhibited and explained a model showing the orbit of the comet of 1812, and Mr. J. R. Robinson described his safety-seam steam-boiler. Mr. Robinson's first invention consisted in reaming out the edges of the rivet-holes in the plates on the inside, or where they come in contact, making them conical for a short distance.

When the rivet is put in, it flows out and fills the space thus formed, becoming, therefore, of greater diameter at the middle than at the ends. When the plates are under tension, the rivet will cant, and the ring-like projection around its centre will pry the plates slightly apart, as Mr. Robinson has satisfactorily demonstrated by experiment, thus allowing the escape of the steam in the case of a boiler, and avoiding an explosion; while, on the removal of the stress, the plates come tightly together again, provided the strain on the rivet were adapted not to exceed its elastic limit. The simple conical reaming-out of the holes, however, was not found to be just what was wanted; as it was possible for the metal of the rivet to be forced out between the plates farther than was wished, preventing their coming together tightly at all, even at first. To obviate this objection was the object of Mr. Robinson's second invention, which consists in cutting out a small hemispherical ring in each plate around the rivet-hole, and reaming out to this ring, so that when the plates are put together the conical enlargement of the hole at the centre is followed by a chamber in the shape of a circular ring; and into this 'relief-chamber' the metal of the rivet can flow out. But, as the amount of metal to be so forced out is never to be great enough to fill this chamber, the plates are brought closely together in the process of riveting, while the action of the rivet under great pressures is the same as has been described.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Geology. — Prof. L. C. Johnson reports that the Ripley group of the cretaceous in Alabama and Mississippi presents some curious and interesting features. It is an interrupted formation. Beginning in Mississippi, north-west of the Corinth group, it runs southward one hundred miles, and there runs out. It also appears in the extreme south-east, on the Chattahoochee River, in Barbour county, Ala., and extends westward to a point undetermined, but not reaching the Alabama River. It also occurs as a wedge between the elder cretaceous and the great lignitic A.

Chemistry. — The chemical division of the survey is at work on analyses of alkaline and saline waters from the Great Basin, collected by Mr. G. K. Gilbert and I. C. Russell; notably, the waters of Humboldt River, Walker Lake, Pyramid Lake, Mono Lake, Lake Tahoe, etc. There are also on hand, awaiting analysis, specimens of water from Helena hot-springs, Montana, from warm springs of Emigrant Gulch and from Livingston, in the Yellowstone valley, in Montana, collected by Dr. A. C. Peale during the past summer.

Prof. F. W. Clarke is also engaged upon a complete revision of his specific-gravity tables, which form part i. of the Smithsonian Constants of nature.

A white porcelain-like clay from the Detroit coppermine, near Mono Lake, California, proves, upon analysis by Professor Clarke, to be a very pure halloysite, thus adding another to the list of localities for this mineral.

A mineral sent in from Big Springs, Texas, said to occur there in abundance, proves to be a mixture of gypsum and sulphur, the latter predominating.

Miscellaneous. — The topographical parties have all returned to the office in Washington. The total area surveyed during the season amounts to fifty-one thousand square miles.

Early in September, while attempting the ascent of the 'Three Sisters,' a group of peaks in the Cascade range in Oregon, Ensign Hayden, who accompanied Mr. J. S. Diller in his reconnaissance of the Cascade range, was thrown from the edge of a cliff by the crumbling of the rocks, and seriously injured. As a result of the accident, he has recently had to suffer an amputation of one of his legs. The operation was performed at Portland, Or. Mr. Diller, in rescuing Mr. Hayden, was also hurt, but not seriously, by the falling rocks.

The library of the survey has just secured a copy of the 'Codex Cortesianus,' by Léon de Rosny, of which eighty copies have just been published in Paris (1883). The line of Mexican manuscripts for the study of the Maya alphabet, in the library of the survey, is now complete, with the exception of a manuscript in the possession of Señor D. Alfredo Chavero, in the city of Mexico. It is entitled 'A MS. explanation in Italian of the Codex Borgiana, by Fabregat.' Steps are being taken to secure a copy of it for publication.

The manuscript for two survey bulletins has been sent to the government printer: viz., No. 3, 'On the fossil faunas of the upper Devonian, along the meridian of 76° 30′, from Tompkins county, N.Y., to Bradford county, Penn.,' by H. S. Williams; and No. 4, 'Lists of elevations,' by Henry Gannett.

Five volumes of the monographic publications of the Hayden survey are still unpublished. The general direction of the completion and publication of these quarto reports has been put in charge of the director of the geological survey. Two of these volumes are almost wholly in type, and will be issued shortly.

The London *Graphic* of Nov. 17 has a double-page illustration of the Transept in the Kaibab Grand Cañon of Colorado River, which is an engraving reduced from plate xviii. of the atlas accompanying Capt. Dutton's 'Tertiary history of the Grand Cañon' (vol. ii. of the monographs of the survey).

PUBLIC AND PRIVATE INSTITUTIONS.

Massachusetts institute of technology.

The new photographic laboratory. — Since the recent invention of the gelatine dry-plate, photogra-

phy has been advancing rapidly in the number of its applications to the arts and to the industrial and applied sciences. The Institute of technology has not been behindhand in recognizing this fact; and in the new building, now nearly completed, a large room in the south-west corner of the basement has been appropriated to the establishment of a photographic laboratory, perhaps the first ever constructed in connection with a scientific institution, for the especial instruction of students in photographic manipulations, and for purposes of original research, in this most interesting department of applied science.

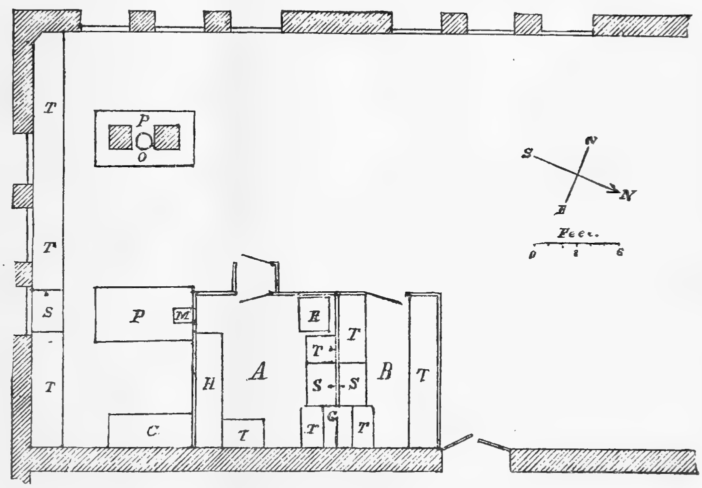
The following plan shows the arrangement of a portion of the room, which measures sixty feet in length by thirty in breadth.

P, *P*, are two brick piers surmounted by solid stone slabs, and constructed on foundations entirely independent of the building, in order to avoid all possibility of shock or jarring. Upon one of these, brick columns are built, which pass through the ceiling into the 'fourth-year' physical laboratory, which occupies the room above. The other one reaches a height of three feet, and forms a solid foundation for the support of a heliostat, microscope, spectroscope, or other instrument. *A* and *B* are the two dark rooms, entirely separated from one another by a partition, and by a wooden frame containing the gas-jet *G*, which is partially surrounded on three sides by sheets of Carbutt's ruby paper. *S*, *S*, *S*, are soapstone sinks, the two former of which are supplied with vacuum pipes for the purpose of accelerating filtration. *T*, *T*, *T*, represent tables, the one in the window being used for printing purposes, while the others are to support photographic apparatus and accessories. Gas will be introduced into the dark rooms over the sinks for lighting when they are not in photographic use. It will also be supplied at the small square table in the larger dark room for heating purposes, such as boiling emulsions. *C* is a case of shelves and drawers to contain books, paper, and apparatus. *H* is a series of shelves for the storage of plates and chemicals. *M* is a square wooden box resting on the pier, but connecting by an aperture measuring ten inches by twelve with the interior of the larger dark room. This is to contain a microscope for researches in photomicrography, the light coming from the heliostat through a small hole in the box. The image is thence projected upon a screen placed inside the dark room, where the operator can examine it at his leisure. This screen is supported upon the focusing table *R*, which rolls upon a track, and may be placed at any distance less than three metres (ten feet) from the aperture at *M*. The dark room is thus converted into a large camera, inside of which the operator stands and exposes his plate, while he may at the same time be developing another one previously taken. The greatest efficiency, convenience, and economy of time are thus combined by this arrangement.

Both dark rooms are constantly ventilated by a system of double walls, with openings at the ceiling and floor, whilst the draught of the lamp *G* is utilized to increase the circulation. The light thus becomes a source of health, instead of vitiating the atmosphere, as is the case in most dark rooms. The room *A* is provided with double doors, so that the operator may leave the room at any time during an exposure, without the slightest fear that even the most sensitive plate could possibly be fogged by a chance ray of stray light. This arrangement, though convenient at all times, will be particularly so when working with long exposures of two or three hours in length; and, indeed, it is only by some such arrangement that these exposures become possible. Besides the aperture at *M*, a smaller one six inches square is made through the wall of the dark room. This is intended for spectroscopic and astronomical work. Either window may be closed by a sliding shutter when the other is in use.

Between the brick columns of the pier *P* is placed a shelf, on which will be kept a large carboy containing a saturated solution of potassium oxalate, from which the developer bottles may constantly be replenished by means of a siphon permanently attached. We thus avoid the trouble of continually making up fresh solutions, and at the same time do not require to have the developer bottles inconveniently large. The hyposulphite-of-soda and sulphate-of-iron solutions will be similarly provided for, the latter being covered with a thin film of oil to prevent oxidation from the air.

The routine work of the department will be arranged somewhat as follows. Only those students at the institute taking the courses in mechanical and electrical engineering, architecture, chemistry, natural history, physics, and the general courses, will



PLAN OF PHOTOGRAPHIC LABORATORY.

receive photographic instruction. Each of them will be required to perform at least ten hours' work, divided into five days of two hours each.

Some experience has already been attained in teaching photography upon a small scale (last year this department had sixteen students); but, should the present venture prove a successful one, it is hoped it may be adopted by other colleges, and that photography may in the future come to be regarded as a necessary portion of every professional man's college education. WM. H. PICKERING.

NOTES AND NEWS.

IT is generally known that Williams college secured a table early last year at Dohrn's international station at Naples. The table may be occupied by any American scientific scholar recommended by the faculty of the college. Any one wishing to use the table should send an application to President Carter, and the application should be accompanied by evidence of ability to improve the unrivalled facilities for original investigation afforded at Naples.

Each occupant is expected, soon after his return, to give a brief course of lectures at Williamstown on some subject connected with zoölogical work. The lectures by the first occupant, Dr. Edmund B. Wilson, formerly fellow in the Johns Hopkins university, are to be given in January and February.

In assigning the table, any regular graduate of Williams college will be recognized as entitled to precedence; but, in case no graduate of the college worthy of the honor is an applicant for the position, the appointment will be determined as far as possible by distinction already attained. The successful applicant will be at once informed of his appointment, and his name communicated to *Science* and the *American naturalist* for publication.

The table is at present used by Dr. Samuel F. Clarke, professor of natural history in Williams college, but will probably be vacated on or before April 1, 1884.

— The department of the interior, at the request of the Italian government, has issued a circular, calling attention to the Bufalini prize of five thousand lire for an essay on the experimental method in science, and giving the conditions under which writers must compete. The character of the essay may be gathered from the following extract from Bufalini's will: —

"Let the learned consider, therefore, whether they can pardon me for daring to appeal to them ten years after my death, and after that every twenty years, to solve the following problem: the necessity of the experimental method in arriving at the truth and the relation of all the sciences being assumed, it is required to demonstrate in a first part how far the said method is to be used in every scientific argument, and, in a second part, to what extent each of the sciences has availed itself thereof during the time that has elapsed since the last competition for a prize, and how they may be brought to a more faithful and complete observance of the method itself."

— According to *Nature*, a meeting was recently held in Sheffield for the purpose of carrying out, in connection with Firth college, a proposed technical department having reference to the trade of the district. Among those who spoke were Mr. Mundella and Dr. Sorby; and all agreed as to the desirability of establishing such a department, and the necessity of educating the captains as well as the privates of industry in the principles of their crafts. For that, Mr. Mundella insisted, is the true technical education. He gave the experience of a friend who has just been visiting the United States, and inspected the means for technical education existing there. The distinct conclusion was, "that there is more skill and intelligence in American industrial pursuits than there is in our English industrial pursuits."

— At the meeting of the Institution of civil engineers, Nov. 27, the paper read was on 'The new Eddystone lighthouse,' by Mr. William Tregarthen Douglass.

The necessity for the construction of a new lighthouse on the Eddystone rocks had arisen in consequence of the faulty state of the gneiss rock on which Smeaton's tower was erected, and the frequent eclipsing of the light by heavy seas during stormy weather. The latter defect was of little importance for many years after the erection of Smeaton's lighthouse, when individuality had not been given to coast-lights; but, with the numerous coast and ship lights now visible on the seas surrounding this country, a reliable distinctive character for every coast-light had become a necessity. The tower of the new Eddystone is a concave elliptic frustum, with a diameter of 37 feet at the bottom, standing on a cylindrical base 44 feet in diameter and 22 feet high, the upper surface forming a landing platform 2 feet 6 inches above high water. The cylindrical base prevents in a great measure the rise of heavy seas to the upper part of the tower, and has the further advantage of affording a convenient landing-platform, thus adding considerably to the opportunities of relieving the lighthouse. With the exception of the space occupied by the fresh-water tanks, the tower is solid for 25 feet 6 inches above high-water spring-tides. At the top of the solid portion the wall is 8 feet 6 inches thick, diminishing to 2 feet 3 inches in the thinnest part of the service-room. All the stones are dovetailed both horizontally and vertically, as at the Wolf Rock lighthouse. Each stone of the foundation-courses was sunk to a depth of not less than 1 foot below the surface of the surrounding rock, and was further secured by two Muntz-metal bolts 1½ inches in diameter, passing through the stone and 9 inches into the rock below, the top and bottom of each stone being fox-wedged. The tower contains nine rooms, the seven uppermost having a diameter of 14 feet and a height of 10 feet. These rooms are fitted up for the accommodation of the light-keepers and the stores necessary for the efficient maintenance of the lights. They are rendered as far as possible fireproof, the floors being of granite covered with slate. The stairs and partitions are of iron, and the windows and shutters of gun-metal. The oil-rooms contain eighteen wrought-iron cisterns capable of storing 4,300 gallons of oil; and the water-tanks hold, when full, 4,700 gallons. The masonry consists of 2,171 stones, containing 62,133 cubic feet of granite, or 4,668 tons. The focal plane of the up-

per light is 133 feet above high water, its nautical range is 17½ miles, and in clear weather it overlaps the beam of the electric lights from the Lizard Point. The lantern is of the cylindrical helically-framed type adopted by the Trinity House. The light is derived from two six-wick 'Douglass' burners, the illuminant being colza-oil. With a clear atmosphere, and the light of the Plymouth breakwater lighthouse (10 miles distant) distinctly visible, the lower burner only is worked at its minimum intensity of 450 candles, giving an intensity of the flashes of the optical apparatus of 37,800 candles; but, whenever the atmosphere is so thick as to impair the visibility of the breakwater-light, the full power of two burners is put in action, with the aggregate intensity of 1,900 candles for the lamps, and an intensity of the optical apparatus of 159,600 candles. This intensity is about 23.3 times greater than that of the fixed light latterly exhibited from Smeaton's tower, and about 3,282 times that of the light first exhibited in the tower from tallow candles. The new tower was built at a distance of 130 feet from Smeaton's lighthouse, a large portion of the foundation being laid below the level of low-water spring-tides. The estimate for the work was £78,000, and the cost £59,255. The first landing at the rock was made in July, 1878, and the work was carried on until December. Around the foundation of the base of the tower a strong coffer-dam of brick and Roman cement was built for getting in the foundations. By June, 1879, the work was sufficiently advanced for the stones to be laid in the lower courses, and every thing was arranged for H.R.H. the Duke of Edinburgh to lay the foundation-stone on the 12th of the month; but, the weather being stormy, the ceremony was postponed until the 19th of August. On the 17th of July, 1880, the cylindrical base was completed, and the 38th course by the early part of November. On the 1st of June, 1881, the Duke of Edinburgh, when passing up the Channel in H.M.S. Lively, landed at the rock, and laid the last stone of the tower. On the 18th of May, 1882, the Duke of Edinburgh completed the work by lighting the lamps and formally opening the lighthouse. The edifice was thus erected and fitted up within four years of its commencement, and one year under the time estimated. The whole of the stones, averaging more than 2 tons each, were landed and hoisted direct into the work from the deck of the steam-tender Hercules, by a chain-fall working between an iron crane fixed at the centre of the tower, and a steam-winch on the deck of the Hercules, which was moored at a distance of 30 fathoms from the rock.

The town council and inhabitants of Plymouth having expressed a desire that Smeaton's lighthouse should be re-erected on Plymouth Hoe, in lieu of the Trinity House sea-mark thereat, the Trinity House made over to the authorities at Plymouth the lantern and four rooms of the tower. After the removal of the structure to the floor of the lower room, the entrance-doorway, and well-staircase leading from it to the lower room, were filled in with masonry, and an iron mast was fixed at the centre of the top of the frustum.

— The U. S. naval institute offers a prize of a gold medal, one hundred dollars, and a life membership, to the writer of the best essay offered on the subject of 'The best method for the reconstruction and increase of the navy.' The judges selected to adjudge the prize are Dr. D. C. Gilman, Admiral C. R. P. Rodgers, Senator J. R. Hawley.

— E. & F. N. Spon announce the publication at an early date of a book on 'Sorghum, its culture and manufacture economically considered,' by Peter Collier; also 'Electricity, magnetism, and electro-telegraphy,' by D. T. Lockwood.

— Professor Gustavus Hinrichs, director of the Iowa weather-service, has again issued an attractive annual pamphlet, entitled this year 'The seasons in Iowa, and a calendar for 1884,' with appropriate illustrations, and much valuable meteorological information. The notable weather features of the several months are given in detail; so that observers may judge at any time whether an occurrence is normal and probably to be continued, or abnormal and likely soon to disappear. The chief peculiarity of the climate is its variability, common to interior stations on the track of frequent cyclonic storms, and of which several striking examples are given; and there is found to be much probability of a cold snap late in January, a snow-storm at the close of April, a cold spell in May, tornadoes in June, squalls in July, heavy local rains in August, and frost early in September. Since 1875, tornadoes have occurred in Iowa on the following dates: April 8, 18, **21**, 23; May 9, 13, 18, 19; June 1, 4, **9**, **11**, 12, 14, **17**, 24; July 2; Oct. 8, 15, 28, 30 (the more severe ones in bold type). June is the month most disturbed by these storms; and directly after it a three-month period, July 3 to Oct. 8, has no record of tornadoes. It is said that the danger from tornadoes in Iowa has been greatly exaggerated. The rainfall maps for every month and for the year are repeated from last year. Precipitation is almost three times as great in summer as in winter. Professor Hinrichs hopes next year to illustrate his annual from home sources exclusively, and asks for sketches and photographs of halos, hail stones, destructive effect of wind and lightning, meteors, cloud-forms, or any other phenomena. Drawings of Iowa scenery, as well as detailed maps of storms, hail, and floods, will all be welcome. We wish the director success in his excellent work.

— The publications of the census office so long expected are now being issued in rapid succession by the Government printing-office. Thus far, three quarto volumes, besides the compendium, have appeared, and several others are very near completion. The three which have been issued are those upon population, manufactures, and agriculture. The first, which saw the light some two months ago, comprises 'Population, part 1,' as issued by the census office a year and a half ago, with, as additions, the tables relating to race, nativity, age, sex, parentage, occupations, illiteracy, the defective, dependent, and delinquent classes, and the newspaper and periodical press. The tabular matter is preceded by a somewhat full discus-

sion of the progress and movement of population, which is illustrated by numerous colored charts relating to the progress of settlement, and the distribution of the different elements of the population. Other subjects, such as inter-state migration, immigration and nativity of the population, and occupations, are ably discussed by the late superintendent, Gen. Walker, in remarks introductory to the tables relating to these subjects. The volume is a bulky one, contianing, with its full index, 1,050 pages. It contains, also, forty-two colored maps, of which twenty-eight are double-page maps, and thirty other full-page illustrations.

The volume upon manufactures, which has but recently appeared, is an equally bulky tome, comprising 1,248 pages. The opening discussion, by Gen. Walker, is brief, comprising but thirty-five pages; and, while it is suggestive rather than exhaustive, it skims the cream from the whole body of statistics. The tables present: 1°. General statistics regarding manufactures, by states and territories, in 1880, 1870, 1860, and 1850; 2°. The statistics for the whole country, of certain specified industries, some three hundred and fifty in number; 3°. Similar statistics for each state and territory; 4°. General statistics by counties; 5°. Statistics regarding selected branches of manufactures by counties; 6°. The manufactures of a hundred leading cities; and 7°. Special statistics regarding certain leading industries. The statistical portion of the volume occupies four hundred and seventy-six pages. The report of Mr. Hollerith upon 'Power' consists of tables, showing by states the amount of steam and of water power in use, and also the power applied to certain leading industries in the several states. The statistics are prefaced by a few pages of discussion, in which the leading points are brought out. The report is accompanied by four colored charts of the eastern part of the United States, showing, by shades of color, the total power in use, the steam-power, and the water-power, each in proportion to area, and the local excess of steam and of water power. There are also three sheets of diagrams, illustrating the proportions of power in different industries and in the several states and territories. In his able treatise upon the Factory system of the country, Col. Wright sketches the origin and history of that system; treats of its evil effects, both moral and physical, particularly upon women and children, of its influence upon wages, prices, and production; and summarizes the legislation of the several states in regard to factory operatives. To the houses of factory operatives he devotes much attention, illustrating his text with plans and elevations of many houses for operatives, selected from foreign and American examples. This paper is a very instructive one, both economically and socially. The report of Mr. Fitch, upon Interchangeable mechanism, treats of the manufacture of fire-arms, ammunition, sewing-machines, locomotives, watches, clocks, and agricultural implements. He sketches the history and progress of these branches of manufacture in this country, and details the most recent improvements. This report, as well as that by the same author upon hardware and cutlery, is fully illustrated with cuts. The report upon Iron and steel production, by James M. Swank, secretary of the American iron and steel association, is here reprinted. It was first issued by the census office as a separate publication, being the first complete report published by that office. Mr. Swank precedes the statistics of production by a very full discussion, and closes the report with an extremely interesting and valuable history of the iron and steel industry, not only in this country, but in the civilized world; beginning with Tubal Cain, in the seventh generation after Adam. The report is illustrated with six double-page charts, showing the iron-producing regions of the country, and the production, by counties, of pig-iron, rolled iron, wrought-iron blooms, and steel. The report upon Silk manufacture, by Mr. Wyckoff, consists of a summary of its history, and a very full sketch of its present condition in this country. That upon Cotton manufacture, by Mr. Atkinson, is extremely brief, comprising only sixteen pages: it opens with a summary of the cotton-producing countries of the globe, the sources of supply of the staple, and goes on to discuss the methods of manufacture, and the relative qualities of the product of this and European countries, and the facilities offered by different parts of this country for this industry. The report of Mr. Bond consists entirely of statistics relating to the industry of wool manufactures, prefaced by a few introductory remarks. The report upon Chemical products treats of the production of soda, manufactured manures, phosphates, sulphur and sulphuric acid, potassium bichromate, potash, phosphorus, borax, bromine, nitro-glycerine, acetate of lime and salt. The volume closes with Mr. Weeks's report upon Glass manufacture. In addition to full statistics regarding this industry, Mr. Weeks summarizes and discusses the statistics fully. This portion of the report is followed by a treatise upon glass, the materials used in its manufacture, and the methods employed both in manufacture and in working. The report closes with a history of the industry from the earliest historic times. An admirably full and complete general index is given, in addition to the indices to the several reports. Probably with a view to a separate publication of each special report, each is paged by itself on the top, while at the bottom the paging runs consecutively through the volume.

— S. E. Cassino & Co. desire us to state that they have bought the interest of Estes & Lauriat in the 'Standard natural history,' and are now the sole publishers of that work.

Mr. J. H. Emerton, whose name was given as a contributor to this work, writes that he is only so in so far as a part of the chapter on spiders is quoted from what he had published elsewhere.

— *La Nature*, Dec. 15, 1883, apologizes for an error in stating that Mr. Ferry crossed the English Channel on the water-tricycle figured in *Science*, Dec. 14, and gives illustrations of the tricycle, convertible into a boat, in which the passage was actually made.

SCIENCE.

FRIDAY, JANUARY 25, 1884.

COMMENT AND CRITICISM.

Mr. A. Graham Bell's recent communication to the Washington philosophical society, discussing various common fallacies as to the dumbness of deaf children, is a clear and convincing presentation of the arguments for teaching deaf children with no defects in their vocal organs to speak, though they cannot learn as other children do, being unable to hear. To teach lip-reading is certainly practicable in many such cases, if not in all; and therefore it would seem that the attempt ought to be made in every case, to the exclusion of a purely conventional language of signs. Mr. Bell points out the real nature of the problem and its difficulties, indicating, among other things, the importance of the context to the deaf lip-reader in distinguishing words which look alike to his eye, such as *pat*, *bat*, *mat*, because he cannot see the workings of all the organs of speech, and laying emphasis on the fact that even very imperfect speech, if intelligible, is far better than no speech at all.

After reading his communication and the discussion which followed, especially his answer to objections and to arguments for the use of signs in teaching the deaf, we must give full assent to all the essentials of his arguments. Any student of linguistic science realizing the importance of a clear conception of the nature of language, and the value of careful phonetic analysis, will find this paper of interest, and must hope for the spread of such views as those here expressed, in the interest of his own studies as well as of the deaf-mutes, who may yet be taught to speak.

There is an entertaining field for some linguistic geographer to cultivate in this country by mapping out the distribution of the various kinds of town, county, river, and other names according to their origin and derivation. The great bulk of newer names has no significance in this regard, being purely local, personal, and commonplace; but places of older date often give an interesting clew to the former homes of their first settlers. Distinctively English names have but a slight penetration beyond the Atlantic coast, except in Canada. The French follow a well-marked line up the St. Lawrence and down the Mississippi. Dutch and German names give local color to the Hudson valley and parts of eastern Pennsylvania; and the Spanish have a broad occurrence in the far south-west. Indian names occur everywhere, from the euphonious Minnesota to the doubtful Tuscaloosa and the abrupt Oshkosh. The proper sorting-out of these last would require a rarer knowledge, as it would give more valuable results than the rest of the work; but all might be graphically shown with great clearness.

The hydrographic office of the U. S. navy department has issued the Pilot chart of the North Atlantic for January, on which are given the latest reported positions of floating wrecks. The number of such wrecks which were reported as seen from Nov. 22 to Dec. 25, and of which the positions are charted, is twenty-two. Nine of them were along the eastern coast of the United States, from Maine to Cape Hatteras; seven were on the Atlantic, in the track of vessels going from the United States to England; two were near the West Indies; and three off the coast of Spain. Some months ago the more or less impracticable suggestion was made, of employing naval vessels to chase these dangerous obstructions, and blow them to pieces. The navy department has done good work in locating their positions; but, on account of the winds and ocean-currents, the results can only have value for a short time. It is desirable that some

way should be invented of doing away with this additional danger of ocean travel.

It is not uncommon to hear complaints of the methods of teaching geography in our lower schools. The faults most frequently mentioned are, that the beginning is not made properly; that there are too many lists of places committed to memory; and that the teaching is too lifeless, and is not made real enough by illustration and description apart from the text-book. The first error can be easily corrected by adopting the German method of instruction, where, instead of beginning with the definitions of meridians and parallels, that are so often found misplaced on the opening pages of our text-books, the pupils first study the arrangement of the schoolroom, then of the playground, next the geography of the town and of the surrounding country, and thus learn the meaning of the maps from which they afterwards study about the more distant parts of the world.

But this does not go very far. After laying the proper foundation, is there any way of learning geography, except by committing to memory the names and relative positions of the many mountains, rivers, capes, bays, lakes, cities, and towns, that give features to the earth? Detail may, of course, be carried too far, if a precise knowledge of distant, and to us unimportant, countries be required; but for the average scholar of this country, who should become well acquainted with the geography of North America and Europe, there is no easy path, no royal road, over the broad, rough field of fact that he must cross. We fancy, therefore, that the second criticism touches, not a fault, but a difficulty inherent in the study. Names and positions of places must be learned; but, as books of moderate cost can give very little more than the barest mention of them, the study is apt to become lifeless, and to degenerate into the learning of dull words from a dead map, unless the teacher averts this unfortunately common result, and enlivens the work by instruction beyond the text-book. This, however, is more than we have a right to expect from the overworked and underpaid teachers in the lower schools, for it is no easy task. It demands much reading in many books; it requires illustration by numerous maps, photographs, and diagrams, far beyond the reach not only of the teacher, but of the school board as well. In short, the desirable, the ideal teaching of even so commonplace a subject as elementary geography is an expensive art, requiring much study, high skill, and an extensive outfit.

It is now recognized that the successful teaching of chemistry, physics, and natural science, needs that the teachers of these branches shall know them by practical, experimental, observational work. A fair application of the same principle would require that the teacher of geography should have travelled; but how far are we now from so desirable an end! It is safe to say, that, of all the teachers of our common schools, not one-quarter have seen an ocean, a harbor, or a high mountain, and not one-twentieth of them have had any personal acquaintance with the foreign countries that they have to describe. Under these conditions, it is certainly no wonder that the study of geography becomes so often a tiresome exercise of unintelligent memory; and it cannot be otherwise, without a cost that few school boards can allow.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Naval officers and the coast-survey.

In your issue of the 11th you refer editorially to the proposition contained in the report of the secretary of the navy for 1883, to transfer all national work connected with the ocean, and conducted by other departments, to the control of the navy department; and in a subsequent paragraph you make some criticisms upon the character of the work performed by navy officers in the coast-survey. The question as to whether the navy or the treasury department shall control the work, I do not propose to discuss; but I must enter my protest against the assertion in a journal like *Science*, which goes forth to the world as authority, that the "work which these [navy] officers perform is routine, the plans and methods for which have been devised and developed by civilian experts," and to the assertion contained in the phrase, "the present method of employing our superfluous navy, under the intelligent supervision of

civilian experts."— To answer these points in order, I will say, first as a matter of history, that the 'plan' of the coast-survey was compiled over forty years since by a mixed board composed in part of navy officers. This plan was legalized by Congress in 1843–44, and has been mainly in force ever since; though some modifications have necessarily been made by the judgment and experience of the eminent men who have held the offices of superintendent and principal assistants. By the plan referred to, it was made the *legitimate* duty of officers and men of the navy to execute the hydrographic part of the work; and to them has ever since been assigned the bulk of that work, except during the few years when the civil war and the subsequent scarcity of officers made it impossible to do so. That period (i.e., from 1861 to 1871) developed a good many civilian hydrographers who have no superiors in the world, but nearly all of these resumed their more legitimate work upon the return of navy officers to the survey. The *methods* of hydrography are the growth of hundreds of years, and have been contributed to by the seamen of all maritime nations; and, while the inventors of a good many instruments and special methods are known, it would be exceedingly difficult to trace the *system* to its source. The 'tricks of the trade,' so to speak, have been handed down from one to another with gradual improvement, — as a rule, too slow to give any definite point from which that improvement can be shown, though during the forty years of its existence the coast-survey has vastly improved the character of its work; but probably the improvement in its means (i.e., the introduction of steam-propelling power, etc.) deserves a good deal of the credit for improved methods. While civilians have had a share in the development, it is a long way from the fact, to ascribe all to them, as it is to assume that hydrography is a work which does not require skill, judgment, and care. Those who think the last have never worked in intricate waters. The officers engaged upon the coast-survey have been so assigned because it was a part of their regular duty, and not because 'superfluous.' Having had for five years the privilege of nominating the officers to be employed upon the coast-survey, I can speak with some authority. Officers were chosen strictly for their qualifications; and often, had it not been for the great interest taken in the coast-survey by the successive chiefs of the bureau of navigation, the officers selected would not have been spared from other duties. That all work of the coast-survey is supervised by the superintendent, an expert of high order, is an undoubted fact; but his instructions to hydrographers, unless he has some special object in view, simply assign geographical limits, but do not prescribe methods, a general printed manual covering all that is required in the latter. The work, after completion, has of course to pass the rigid scrutiny of the superintendent; but the same is the case with all other work. To this extent the work of navy officers may be said to be 'supervised by civilian experts,' but no farther. In 1873 several navy officers, who without previous experience were ordered to the coast-survey, placed themselves for a short time under the instructions of civil assistants, who had been doing their work for some years; and all of them freely and gratefully acknowledge the assistance they received. I am free to acknowledge obligations of a similar character,— of many a *point* received from my valued civil associates during the Darien Canal expedition of 1870. Nautical surveying has always been taught theoretically at the Naval academy; and as much practice as possible has generally, though not always, been given. Furthermore, nautical surveying and navigation are very near cousins, so that all the instruction needed to make a navigator a surveyor is to give him what I have called the 'tricks of the trade;' and these are being handed down by officers as they have been by their predecessors. EDWARD P. LULL,

Captain U.S. navy, late hydrographic inspector U.S. coast geodetic survey.

[The plan of organization of the coast-survey and the plan of work of the survey are quite different things. It is the duty of the chief of the survey to arrange and supervise the latter. That the scope and character have been extended since its organization in accordance with the views of the chief is beyond question. While from the above letter it might be inferred that the nautical work of the coast-survey is confined to marine surveying in its older sense of locating rocks and shoals, and determining the boundaries of courses of the navigable waters by time-honored methods, yet from the publications of the coast-survey, and from other sources, we had gathered that the study of ocean physics, and of the conformation and character of the ocean bottom, together with the different forms of marine life, had formed, of recent years, an important part of the work of the survey, and that it was carried out in accordance with the plans of the chiefs of the survey, and by the methods devised and developed by them and by the two Agassizs, Pourtales, Thompson, Milne-Edwards, and many other eminent specialists, modified in minor details by the circumstances of each case.

It is an error to suppose we regard the employment of naval officers in this work unfavorably; for, on the contrary, we think it highly desirable that they should be employed in this routine work of collecting data and material for discussion and study by specialists; and their skill, judgment, and care, their knowledge of organization and discipline, and their close adherence to instructions, render them extremely useful. It is wise, also, that, in the present reduced condition of the navy as to ships, and its overcrowded condition as to officers, the secretary should find employment for this superfluity in the coast-survey, the fish-commission, the geological survey, the national museum, as instructors in our colleges, and as assistants in special researches. Such employment cannot but result in benefit to the navy, and assist in the advancement of science.

Yet we have still to be persuaded that it will promote the efficiency or the economy of the scientific organizations of the government if they are transferred from the supervision of the present expert civilian heads to that of the officers of the navy.]

Italics for scientific names.

I agree with the editorial remarks under this heading in *Science*, No. 49, that the proper mission of italics is for 'emphasis, or as catch-words;' and their use for scientific names of animals and plants is, it seems to me, — contrary to the opinion conveyed editorially, — of great practical utility, especially in indexing, or in searching the pages of an article or memoir for references to particular species that may be under treatment. Italicizing such words makes them 'catch-words,' and gives great facility in discovering incidental reference to species, the eye quickly catching the italicized name, and as quickly recognizing whether it is the one sought. Considering scientific names as 'a simple convenience,' and as having no higher value, their use is so necessary as

a 'handle to facts,' or as names of objects of which we have to speak, it seems desirable to have them so typographically distinguished that their presence on a printed page will quickly catch the eye as guide-posts to the subject of the immediate context.

J. A. ALLEN.

Cambridge, Mass.

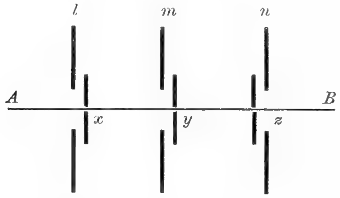
[The editor has yet to be convinced that typography should be moulded to suit the purposes of an indexer.]

Eating horns.

Indians eat the horns of the deer when in the velvet. One day on the Sioux Reservation, in Dakota, a deer was killed near camp, and brought in entire. At sight of it, Pahlani-ote, a Minneconjon of some fifty years, dropped his usual statuesque attitude, knocked off the horns, and, seating himself by the fire, began at the points to eat them, velvet and all, without cooking, as if they were most delicious morsels. The others of the party looked on as if they envied him. They said they always ate them so. S. GARMAN.

Radiant heat.

In a letter to *Science* of Dec. 21, 1883, Dr. Eddy has endeavored to show that I was mistaken in thinking that his proposed arrangement for proving that radiant heat is not subject to the second law of thermodynamics would not work.



I can most easily explain how Dr. Eddy is again mistaken by referring to my diagram which he reproduces in his letter. Dr. Eddy says that *every* time the door z is opened two quantities of heat pass into the region B, one of which had originally come from A, and the other from B. I had assumed that the occasions when it opened to let heat that had come from A pass were different occasions from those when it opened to let that from B pass. I assumed this, because I could see no way of getting the heat that had come from B back again through z in the same direction as it had come out, except by a reflection from the back of y; and of course that required y to be shut at the time of reflection, so that this heat could not reach z at the same time as any heat that had originally come from A. I have been unable to think of any method of getting the heat from A and what had come from B to travel *simultaneously* in the same direction; and I am inclined to think, that, if this were possible, Dr. Eddy's doors, etc., would not be required to enable A to radiate more heat to B than B does to A. This supposed arrangement might, as far as I can see, go on working continuously, returning the heat to B, and simultaneously transmitting that from A; for this seems to me to be what Dr. Eddy postulates as possible.

If the two quantities pass into B through z in two different directions, then two other quantities will escape from B in these two directions, and B will be in exactly the same condition as it would be according to my hypothesis that they passed into B at different times.

Dr. Eddy confesses to being unable to see how to accomplish what he postulates with my arrangement of screens and apertures; and I believe that the only reason he is unable to do so, and imagines that his own proposed whirling tables would do so, is because my arrangement is so much simpler than his, that it is almost impossible to be misled as to where and when the heat comes in and goes out; while, with his arrangement, he has so many holes that it is almost impossible to keep before one's mind all that is supposed to be going on. I cannot see how my simple arrangement is less general than Dr. Eddy's complicated one, as it seems to me that a multiplicity of holes cannot be of any real use, while they produce very serious complication; and, except in the number of holes, I think Dr. Eddy's arrangement only differs from mine in that his supplies a mechanism for opening the apertures, which, of course, has nothing to do with the question. If Dr. Eddy will explain how he manipulates so as "to bring the heat coming from A into a position such that it would be in readiness to pass into B at the same time," *and in the same direction*, "as the heat which originally came from B is returned to B," and does not rest upon the authority of Professor Gibbs that his arrangement does so, then I will agree that he has invented an arrangement by which the second law of thermodynamics may be cheated. GEO. FRAS. FITZGERALD.

40 Trinity college, Dublin,
Jan. 7, 1884.

Professor De Volson Wood makes statements in his letter published in your issue of Jan. 11 which appear to me unsupported by facts. Were your columns open to a lengthy discussion, I should like to show this in detail. Suffice it to say, that in his reference to Mr. Fitzgerald's construction he entirely overlooks the difference between radiant heat, which must be moving along given lines in a determinate direction, and other heat. The heat referred to as 'entangled in the space $m\ n$' is radiant heat alone. I have definitely traced its path, and shown that it does not move as Professor Wood states. Instead of regarding this fact, he has attributed to it the properties of heat as ordinarily existing in matter.

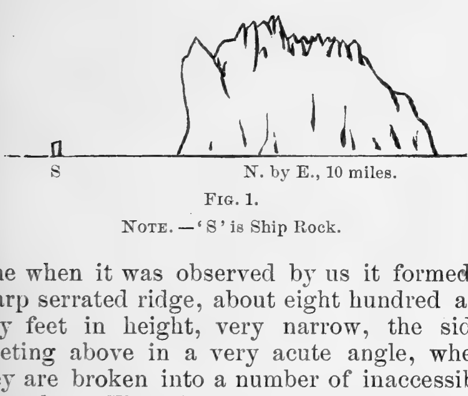
Professor Wood also refers to his papers in the *American engineer*, etc. The only point in that somewhat lengthy and personal discussion upon which I understand Professor Wood to finally insist, he republished in the *Journal of the Franklin institute* for May, 1883. In my reply in the same journal for June, 1883, I showed the fallacy of his objection. So far as I know, Professor Wood has taken no notice of that reply, and now completely ignores it. I may say that the proof he relied upon was of this nature. He proposed a certain construction or process (differing essentially from mine) for dealing with radiant heat, and one which would not accomplish the end sought. He then showed that his construction was a failure, and concluded that mine would therefore fail also, — a method of reasoning which seems to me inconclusive, to say the least. And now Professor Wood says that Mr. Fitzgerald's construction is 'conclusive.' All it is conclusive of is, that it will not accomplish the end which I have proposed: we all agree that it will not. I have shown, however, that my proposed construction differs from both in just those particulars necessary to make it accomplish the end sought.

It is unfortunate that the velocity of radiant heat is such as to render experimental verification a matter of great difficulty. H. T. EDDY.

A NEW VOLCANO ISLAND IN ALASKA.

RECENTLY the newspapers have contained references to the rise of a new volcanic island near Bogosloff Island in the Aleutian chain. Bogosloff itself is believed to be a recent development. Possessing some unpublished material and some sketches bearing on this topic, it has been suggested that a *résumé* of the subject would not be without interest for the readers of *Science*.

The island of Ioanna Bogoslova (St. John, the theologian), or Agáshagok of the Aleuts, is commonly known by the shorter name of 'Bogosloff' to the white residents of the region. Owing to its isolated and remote situation, it has been rarely visited, and hence is less widely known than other modern volcano-islands. It is, however, one of the few instances of the sudden and violent formation of land in the sea which have been witnessed in historic times. It is situated in latitude 53° 58′, and longitude 168° west, approximately some forty-two miles west of the northern corner of Unalashka Island of the Aleutian chain. At the

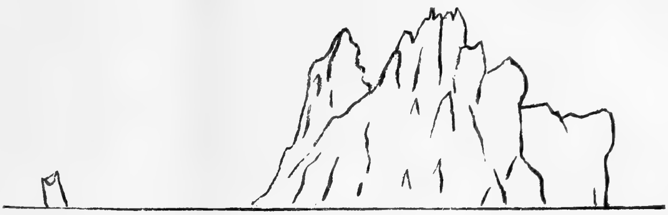


S N. by E., 10 miles.

FIG. 1.

NOTE.—'S' is Ship Rock.

time when it was observed by us it formed a sharp serrated ridge, about eight hundred and fifty feet in height, very narrow, the sides meeting above in a very acute angle, where they are broken into a number of inaccessible pinnacles. There is no crater, nor appearance of a crater. The shore-line formed a tolerably regular oval, pointed at the south-east end, having its longitudinal axis trending N. W. ¼ W. and S. E. ¼ E. by compass, and reaching about three-quarters of a nautical mile in length. The shores are mostly precipitous; but at the south-eastern extremity the waves have accumulated a small spit or pointed bit of beach, of talus, on which in perfectly favorable weather a landing may be had. With the least swell a heavy surf is formed here. Seen through a strong glass at a distance of four miles, it appeared of a light pinkish-gray color, devoid of vegetation or water, and covered with myriads of birds. Less than half a mile north and west from the island is a perpendicular square-topped pillar, about one hundred and fifty feet high, called on modern charts 'Ship Rock.' Less than half a mile north and east from the island is a small rock rising only a few feet above the water. North, east, and south, and

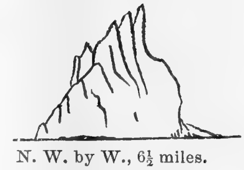


S North, 4 miles.

FIG. 2.

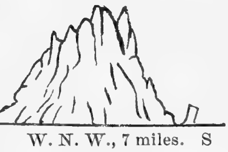
especially east-south-east from the point of the island, scattered breakers were observed, extending less than three-quarters of a mile from shore. The crags of the main island afford the most secure refuge to thousands of sea-parrots, puffins, auks, and divers; and sea-lions (Eumetopias Stelleri) often rest on the talus point. It is visited in spring, if weather permits, by native egg-hunters from Unalashka; but in 1873 several years had passed since any one had been able to make a landing at the proper season. My own party attempted it unsuccessfully in 1872 and 1873.

Such was the condition and appearance of the island in 1873. The outline sketches here given are facsimiles of those taken on the spot as we approached the island from the south-west, and passed south of it eastward toward Unalashka. Their proportions were corrected by horizontal and vertical angles. The wind



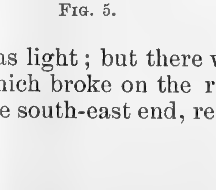
S N. by W., 6 miles.

FIG. 3.



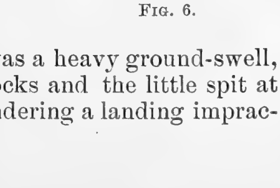
N. W. ¼ W., 6 miles.

FIG. 4.



N. W. by W., 6½ miles.

FIG. 5.

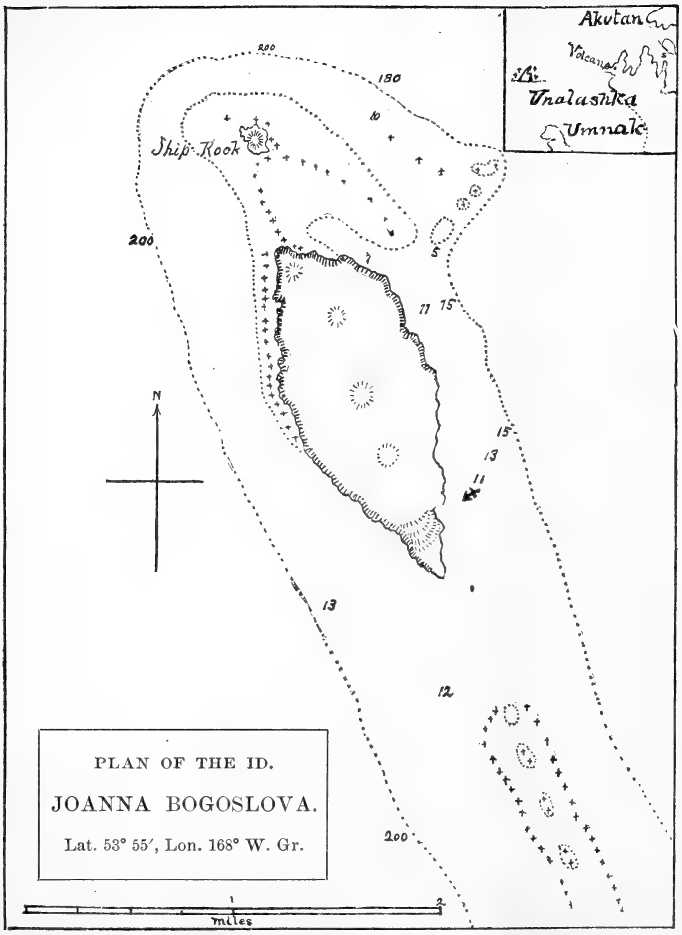


W. N. W., 7 miles. S

FIG. 6.

was light; but there was a heavy ground-swell, which broke on the rocks and the little spit at the south-east end, rendering a landing imprac-

ticable. On the line of the supposed reef, which has ornamented the charts for so many years as connecting Bogosloff and Umnak, three miles from the island, we sounded in eight hundred fathoms without touching bottom. With the exception of a small reef near the north-east end of Umnak, and the rocks within a short distance of Bogosloff, there is water more than eight hundred fathoms deep



PLAN FROM KRUSENSTERN'S ATLAS, 1826.

on all sides of the island. The supposed reef was probably taken for granted by those who saw the white water of a tide-rip which eddies southward toward Umnak Pass on the ebb, in the wake of Bogosloff, as we ourselves observed to occur in a small way. Ship Rock is seen on several of the sketches, standing off to the northward. The earliest information in regard to this island is derived from the map of Krenitzin and Levasheff, prepared from surveys made in 1768–69. No reference to it appears in the abstract of their report which has been preserved for us by Coxe; but a little profile surrounded by rocks is represented off the end of Umnak on their chart, which evidently represents the rock which existed before the present peak was raised. A facsimile of this part of their map appears in the corner of the Krusenstern map on this page.

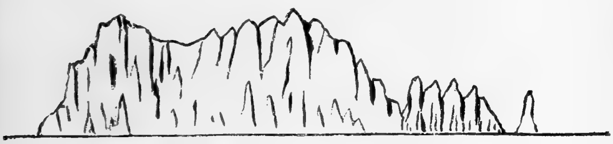
The next information is given by Cook's voyage in 1778, when an elevated rock, like a tower, was seen Oct. 29, at a distance of twelve miles: 'The sea, which ran very high, broke nowhere but against it.' On Cook's chart it is called Ship Rock, but its identity with what is now known as Ship Rock is uncertain; and at that distance there might have been a number of adjacent rocks or breakers not visible.

We learn from Langsdorff, who visited this region from 1804 to 1806, that, previous to the appearance of the present peak of Bogosloff, a rocky islet had long stood in the same situation, which the Aleuts declared from the time of their forefathers had been a notable resort of seals and sea-lions. This could not have been the present Ship Rock, which is a huge perpendicular pillar.

In 1795 the islanders marked a local appearance, as of fog, in the neighborhood of this rock, which did not disperse even when the rest of the atmosphere was perfectly clear. This created much uneasiness, since the natives of Umnak and Unalashka had been used to regard this rock as one of their great sources of food-supply. After a long time, in the spring of 1796, one of the more courageous natives visited the locality, and returned immediately in great terror, saying that the sea all about the rock boiled, and that the supposed fog was the steam arising from it. It was then supposed to have become the abode of evil spirits, and was avoided by every one without exception. The disturbances were accompanied by volcanic activity in the craters of Makushin on Unalashka and others on Umnak Island. The account given by Baranoff and Veniaminoff of what followed may be

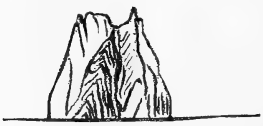
summarized, it being remembered that the island is over thirty miles from the nearest land, and about forty from the nearest habitations on Unalashka.

On the 1st of May (old style), 1796, according to one Kriukoff, then the Russian American company's agent at Unalashka, a storm arose near Umnak, and continued for several days. During this time it was very dark, and low noises resembling thunder were continually heard. By daybreak on the 3d of May the storm ceased, and the sky became clear. Between Unalashka and Umnak, and northward from the latter island, a flame was seen arising from the sea, and smoke was observed for ten days about the same locality. At the end of this time, from Unalashka, a rounded white mass was seen rising out of the sea. During the night, fire arose in the same place, so that objects ten miles off were distinctly visible. An earthquake shook Unalashka, and was accompanied by fearful noises. Stones, or pumice, were thrown from the new volcano as far as Umnak. With sunrise the noises ceased, the fire diminished, and the upraised island was seen as a sharp black crag. It was named after St. John the theologian, though it does not appear for what reason. It did not rise, according to the above account, on his day. A month later it was appreciably higher, and emitted flames constantly. It continued to rise, but steam and smoke took the place of fire. In 1800 the smoking appeared to cease, and in 1804 a party of hunters visited the island. They found the sea warm about it, and the surface, in some places at least, too hot to walk upon, even if the distorted fragments of lava, which formed its base, were accessible to a landing. It was said to be two miles and a half in circumference, and three hundred and fifty feet high.



Pinnacle Island, W. S. W., 10 miles.

FIG. 7.



Pinnacle Island, N. N. W., 6 miles.

FIG. 8.

In 1806 fissures appeared, lined with crystals of sulphur. According to Langsdorff, who saw it in this year,[1] it did not exhibit any special activity, though steam and smoke arose more or less constantly. In this year three baidars visited the island. On the north side soft lava flowed into the sea, and it was too hot to approach closely; but on the southern end a landing was effected. The peak was too sharp and rugged to be ascended, and the rock was very hot. A piece of seal meat suspended in a crevice was thoroughly cooked in a short time. There was no soil nor fresh water.

The only map or survey of Bogosloff and vicinity known by us to exist is that of Krusenstern, published in 1826, a facsimile of which is here given, except that the evidently formal hachuring has been omitted. Since 1823, and up to the present year, the island has remained tranquil, and its form has not changed. The close similarity to our own, of Lütké's profile taken in 1827, confirms this view. The widely differing estimates of its height and area given by Grewingk illustrate the futility of unchecked guessing rather than any change in the island itself; and even the map, which could have had no base-line except one measured by log on the water, though relatively correct, represents, according to our observations, a scale about one-quarter too large, the island being about a mile and a quarter long, instead of a mile and three quarters, as the map gives it.

We have not space here to discuss the detailed process by which our conclusions have been reached, but will briefly state them.

The site of Bogosloff was a low islet or cluster of rocks not identical with the present Ship Rock, and which were long known to the Aleuts, and mapped by Levasheff. In 1795–96 a series of progressive disturbances occurred by which, in May, 1796, a considerable mass of material was upheaved and the major part of the present island formed. The reports of exactly what occurred, as well as the dates assigned, are discrepant and all unsatisfactory, when we recollect the distance from which the alleged observations were made, and that they were not noted down until several years after-

[1] In 'Alaska and its resources,' by an accident in the historical chapter, the item relating to the rising of this volcano from the sea was misplaced ten years, and appears under 1806, though properly dated in the geological chapter. An agent of the census by the name of Petroff, believing apparently that a little imagination would enliven his statistics, and misled by this erroneous date, gives in his report an account of an eye-witness of the phenomenon, 'born in 1797,' and 'who was one of the individuals who first noted' it, and with such terror 'that his trembling knees could scarce carry him back to report!' (H. R. ex. doc. No. 40, p. 19, 1881.)

ward. The reef shown on most charts extended only a short distance from Umnak or Bogosloff, and was never continuous between them.

Other islands of exactly similar origin are to be found in this region, notably Koniúgi and Kasátochi in the western Aleutians, and Pinnacle Island near St. Mathew Island. Of the last, sketches are reproduced here, showing it 'end on' and from the side. It differs from Bogosloff in having the crest deeply channelled; and it has been reported, that within a few years light has been seen in this fissure by navigators passing at night, though there is no record of smoke or lava being ejected.

Of the latest addition to the list of Aleutian volcano-islands, we are not in a position to say much. The facts reported seem in brief to be these: —

During the past season, Bogosloff has been in a state of eruption, as was observed by Capt. Hague, of the steamer Dora, on two occasions, when passing it at a distance of a mile and a half. He describes it as entirely enveloped in smoke and flame, with red-hot lava issuing from its central portion, and great quantities of softer lava running down to the sea. This has continued up to the time of the latest reports. The natives state that the eruption began about six months ago, and has continued in an intermittent manner ever since. Makushin volcano, on Unalashka Island, remained quiet. On the 16th of October a dark cloud of indescribable appearance covered the sky northward from Unalashka, and hung very near the earth for some time, completely excluding the light of the sun, and accompanied by a rise of temperature in the air. In about half an hour this cloud collapsed, and covered the earth with dull gray, cottony ashes of extreme lightness. This was ascribed to the Bogosloff eruption which had been heard of, though not visible from Iliuliuk harbor, where these observations were made. Another account says the fall of ashes occurred Oct. 24, and that the amount has been exaggerated.

Subsequently Capt. Hague passed again in the vicinity of Bogosloff, and, to his astonishment, observed a new island which had appeared above the sea since his previous visit, and in a spot which he had previously sailed over. In the month of September Capt. Anderson, of the schooner Mathew Turner, had observed the new island, which was then a mass of fire and smoke, apparently not having taken shape. Capt. Hague reports the new peak to be situated half a mile north-north-westward from Bogosloff, to be cone-shaped, with an irregular outline, rising five to eight hundred feet above the sea, and about three-quarters of a mile in diameter.

It is stated that no further information was obtained; and none is likely to be obtainable until next spring, as communication with Unalashka is not kept up during the winter months. To examine it, a special expedition from Unalashka would be necessary; as it cannot be much less than forty-five miles from Iliuliuk harbor, in the open sea, and would be little more than visible from the nearest land. I would suggest for it the name of Grewingk Island, in honor of the celebrated geologist who monographed in 1850 all that was known of Alaskan geology and mineralogy.[1]

Since the above news was received, further intelligence has come to hand in regard to volcanic activity in Alaska, from an unexpected locality. From the entrance of Port Graham, sometimes called English Bay, at the mouth of Cook's Inlet on its eastern shore, may be seen the rounded summit of Augustin or Chernobour Island. It presented in 1880 the appearance of a low rounded dome without a peak, and measured about thirty-eight hundred feet in height by angles from different stations. The island of which it is the summit is about fifty miles from Port Graham in a south-west by west direction, is rounded and about eight miles in diameter, bluff to the north-west, and sloping to the south-east. There are many rocks about it, and it has been a noted haunt of sea-otters. It was known to be volcanic, but no description of it as active is on record so far as I can discover. According to information received from Capts. Cullie and Sands, and summarized for the press by Prof. George Davidson at San Francisco, the following observations were made at the Alexander Village at Port Graham. Smoke first arose from the peak in August. On the morning of Oct. 6 the inhabitants heard a heavy report, and saw smoke and flames issuing from the summit of the island. The sky became obscured, and a few hours later there was a shower of pumice-dust. About half-past eight o'clock the same day an earthquake wave, estimated at thirty feet in height, rolled in upon the shore, deluging the houses on the lowland, and washing the boats and canoes from the beach. It was followed by others of less height. The ash fell to a depth of several inches, and the darkness required lamps to be lighted. At night flames were seen issuing

[1] Capt. Hague proposed to name it New Bogosloff; but the derivation of the word 'Bogosloff' is such that a different name would be preferable.

from the summit, and the snow had disappeared from the island. After the first disturbances were over, it was found that the northern slope of the summit had fallen to the level of the cliffs which form the shore, and the mountain appeared as if split in two. Two previously quiet volcanoes on the peninsula of Aliaska began simultaneously to emit smoke and dust; and in the ten-fathom passage between Augutin Island and the mainland a new island, seventy-five feet high and a mile and a half in extent, has made its appearance. It is stated that subterranean noises had previously been heard by a party of hunters, some of whom are reported missing.

The volcano has not been approached nearer than ten miles since the eruption, at which distance the new island was distinctly seen north-west from Augustin Island. Its dimensions, therefore, are merely approximate. The morning of the eruption was perfectly clear, with a light south-west wind, and the tide extremely low. Three days before, all the fish are said to have disappeared from Port Graham. At last accounts smoke was arising from a point on Augustin Island, south from the cleft above mentioned, which crosses the island from east to west.

It would seem as if these events were local manifestations of an awakening of volcanic energy nearly world-wide. WM. H. DALL.

WHIRLWINDS, CYCLONES, AND TORNADOES.[1]—IX.

TORNADOES differ from the storms thus far mentioned in their excessive violence over a very restricted area, and their visibly rapid advance. After a great deal of theorizing, it is now possible to explain them very satisfactorily and simply as whirls in the air, a little above the ground, into the vortex of which the surface-winds are drawn up with great velocity. Electricity has no essential share in their action.

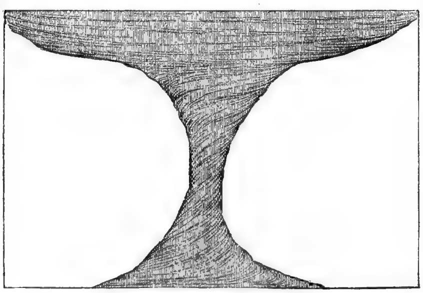
Recent studies, especially the reports by Mr. Finley of the signal-service, have done much to show us the regions of, and general conditions preceding, tornadoes. They are most numerous in Kansas, Missouri, and Illinois, although they have been recorded throughout the states east of the Mississippi, except in the far north-east and on the central Alleghanies. So they have occurred in all the months, and at nearly all hours of the day; but their time of greatest frequency is in the afternoons of June and the months adjoining. Where most fully studied, they seem to occur along the contact-line of warm southerly winds and cooler north-westerly or westerly winds. Local quiet and rather excessive warmth commonly precede them, and chilly winds come after their passage. Rain and hail fall in their neighborhood, but usually at a moderate distance away from the destructive wind-centre. Their advance is nearly always to the north-east, at about thirty miles an hour.

When first perceived, the tornado is generally described as a dark, funnel-shaped mass, hanging from heavy, dark, agitated clouds (fig. 23). Its roaring sound is heard as it comes nearer; and the whirling funnel is often seen to swing from side to side, and to rise and fall. Within its dark column, various objects snatched from the ground may be seen rising and turning round and round in the eddying winds: pine-trees appear like bushes, and barn-doors are mistaken for shingles. At a certain height these fragments are thrown laterally out of the power of the ascending current, and then fall to the ground, often with violence, from their lofty flight. If such a cloud appear in the west or south-west, one should make all possible haste to the north or south of its probable track; but there is seldom time to escape. The rapidity of the storm's approach, the noise of its roaring, the fear that its darkness and destruction naturally inspire, too often serve to take away one's presence of mind; and, before there is time for reflection, the whirl has come and passed, and the danger is over for those who survive. The force of the wind is terrific. Heavy carts have been carried, free from the ground, at such a velocity, that, when they strike, the tires are bent and twisted, and the spokes are broken from the hubs. Iron chains are blown through the air. Large beams are thrown with such strength that they penetrate the firm earth a foot or more. Children, and even men, have often been carried many feet above the ground, and sometimes dropped unhurt. A velocity of wind exceeding one hundred miles an hour is required to produce such effects. Strange examples of the wind's strength are found in the treatment of small objects: nails are found driven head first firmly into planks; a cornstalk is shot partly through a door, recalling the firing of a candle through a board. More than this, the wind shows signs of very unequal motions in a small space: bedding and clothing are torn to rags; harness is stripped from horses. Nothing can withstand the awful violence of the tornado's centre; and yet, at a little distance one side or the other, there is not only no harm

[1] Concluded from No. 50.

done, but there is no noticeable disturbance in the gentle winds. The track of marked disturbance averages only half a mile, and the path of great destruction is often only a few hundred feet wide.

The whirling at the centre is evident enough, in many cases, from the rotary motion of the funnel-cloud: it is, in all reported cases, from right to left, like the cyclones of this hemisphere. At a little distance from the centre, the wind is probably nearly radial, as is shown fully enough by the direction in which fences or trees are blown over, or houses and other loose objects carried. On the right side of the track the winds are more violent, and their destructive effect consequently reaches farther from the whirl than on the left. This is evidently because, on the right, the motion of the wind and the advance of the storm are combined, as has been explained under cyclones. Here are several examples from the Kansas tornadoes of May, 1879, as described in Finley's report, showing the opposed currents of air.



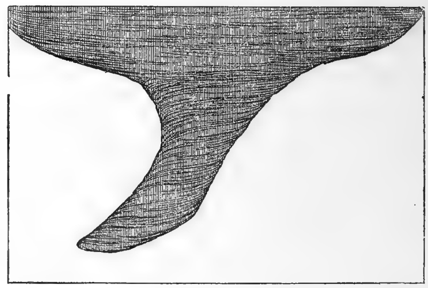


FIG. 23.[1]

Fig. 24 shows the fence on the right blown to the east; the fences on the left, to the west and south; and the hay from a stack, scattered in a curved line. When fences are not blown over, rubbish often collects on their windward side.

Fig. 25 illustrates, by arrows, the direction of the wind, by which several buildings were more or less injured; but most peculiar is the track of a man, who, on coming out of the east side of a barn, was caught up by the winds and carried half way around the building, and there set down very dizzy, but unhurt. At the same time, two horses near by were killed, their harness stripped off and torn to pieces. A scantling four inches square and ten feet long was found driven three feet and a half into the ground, only forty-five feet from its starting-point. A large board sixteen feet long was found two miles to the north-east, where it was identified by the color of its paint.

Fig. 26 shows a more disastrous case. The house was swept away, and its fragments filled the creek to the south-east. The trees west of the house were not hurt; but those in the grove on the track were blown over to the north-east, their bark and leaves stripped off, and their south-western side blackened as if burnt. In such position, branches have been found twisted from right to left about the trunks. As the storm came on, the family occupying the house ran out, turning to the north and west. One by one they were blown away, — first a little girl, who was found dead; then a girl and boy, not seriously hurt; next the mother was thrown against a tree and killed; and last, the father, carrying the baby, and becoming confused in the rushing wind, turned back from his safe flight to the west, was caught up and thrown over one hundred yards to the north-east, and killed. The accounts of tornadoes only too often give a record like this. In six hundred and odd tornadoes, forty are recorded as fatal to the people on their track. In these forty, four hundred and sixty-six lives were lost, and six hundred and eighty-seven persons were injured.

In addition to the violence of the whirling winds, an explosive effect is often noted in buildings where the windows and doors are closed. Doubtless this is one reason why roofs are so generally carried away. Doors

[1] Figs. 23, 24, 25, and 26 are from Finley's Report on tornadoes of May 29 and 30, 1879.

and windows have been blown outward. The four walls of a house have fallen outward from the centre. Still more definite is the account of a railroad-agent who had barred the window-shutters and locked the door of his station after a train had gone by. A tornado passed over it, and burst the window open outwards. Evidently the air of ordinary density within the building suddenly expands as the outside pressure of the atmosphere is taken off when the storm-centre passes. Possibly this action may aid in the plucking of poultry in tornadoes: the unfortunate chickens that are caught near the centre are nearly always stripped of their feathers. So with the remarkable penetration of mud into clothing, which cannot be cleansed by repeated washings: perhaps the air is drawn out as the storm passes, and then the mud is forced closely into the fabric by the returning atmospheric pressure. The ground

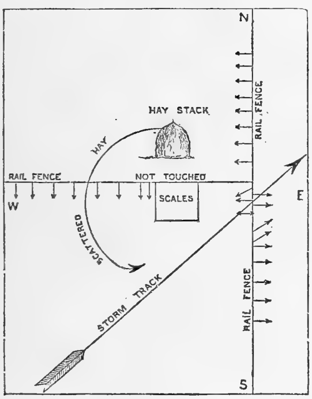


FIG. 24.

is sometimes said to look as if heavily washed on the central path: it may be that the expansion of air in a loose soil aids such a result.

Nothing can be better proven than the existence of a continuous and violent updraught at the centre of the whirl. An observer far enough from the track of the tornado to watch it composedly, and yet near enough to see it with some distinctness, seldom fails to note the rapid rising of *débris* and rubbish in the vortex, whirling as it rises; and a current of air strong enough to lift boards and beams must ascend with great energy. Most of the fragments thus captured by the wind are thrown to one side, and allowed to fall after a short flight; but smaller, lighter objects, such as hats, clothes, papers, shingles, are often carried several miles through the clouds, and dropped far away from home. But observers often report, also, that the extremity of the funnel-clouds is seen to descend, and from hanging aloft it suddenly darts downward to the ground. How can these two contradictory motions be reconciled? Simply enough: for the last is purely an apparent motion. It is simply the downward extension of the cloud-forming space faster than the cloud-particles

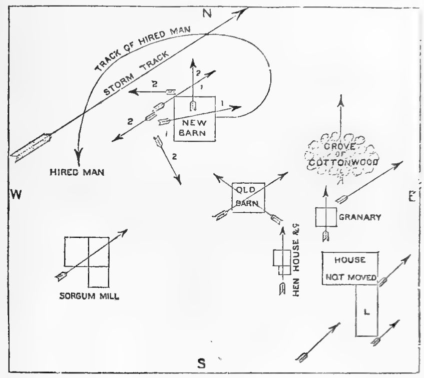


FIG. 25.

are carried upward. The same style of apparent motion against the wind may be seen in some thunder-showers where a cloud forms faster than the wind blows, and so eats its way to windward. There has been much needless mystification here, for the point was neatly explained by Franklin a century and a quarter ago. He wrote, that "the spout appears to drop or descend from the cloud, though the materials of which it is composed are all the while ascending;" for the moisture is con-

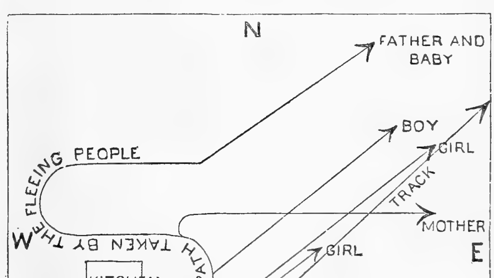


FIG. 26.

densed "faster in a right line downwards than the vapors themselves can climb in a spiral line upwards" (Franklin's Works, Sparks's ed., vi. 153, 154; letter dated Feb. 4, 1753).

Now let us look for the explanation of these varied effects, and discover, if possible, the reason of the extremely local development of such intense motions.

The explanation given for sand-whirls in the desert fails to provide for the excessive force of the tornado. A thin, warm surface-stratum of air would be prevented by friction with the ground from attaining any very excessive velocity; and, moreover, it is often excessively hot without tornadoes following, and tornadoes often happen when the air is not perfectly still. Yet, as they occur most frequently on warm or hot afternoons, surface-warmth very probably re-enforces other causes up to the point of violent storm development.

The existence of conflicting winds, as already noted, gives us more aid. So long as the cold wind passes under the warm, there will be no great disturbance, for the equilibrium will remain stable; but, if the warm wind advances under the cold, an unstable equilibrium may result. We have already seen that warm saturated air requires the smallest vertical difference of temperature to destroy its stability; and also that the saturated condition may often be met in the cloud-stratum, although absent below it. For these two reasons we may infer that a tendency to upset will be more frequently reached a few hundred or thousand feet above the earth than closer to the ground. Suppose that such a condition is reached when a mass of warm southerly wind has pushed itself below the colder north-westerly stratum: the surface-air will often rest quiet and become warm below such a meeting, for the same reason that calms occur along the equator at the meeting of the trades; and a change must soon relieve this unnatural arrangement. The warm wind, feeling about for a point of escape through its cold cover, soon makes or finds a vent where it can drain away upwards; and then the entire warm mass, even a mile or more in diameter, and often more than one thousand feet in thickness, begins the rotary motion already described in whirls and cyclones, rises at the centre, and passes away. Before describing the peculiar tornado features, let us contrast the storm as now developed with the two other kinds of storms already explained. The desert-whirl arises from a thin layer of hot dry air, warmed at the place where the whirl begins, ascending in a small column through a considerable thickness of colder air. Friction with the ground prevents the attainment of an excessive velocity; and the ascending current can lift only sand and light objects. As soon as the bottom-air is drained away, the whirl stops. The cyclone is fairly compared, on account of its great horizontal extension, to a broad, relatively thin disk, with a horizontal measure several hundred times greater than its thickness, having a spiral motion of much rapidity, inward below and outward above, but a central ascending component of its motion so gentle that raindrops can ordinarily fall down through it. Its continuance depends largely on heat derived from vapor condensation: it is therefore self-acting after it has once begun, and goes on drawing in new air long after the original supply is exhausted. The tornado is like a cylinder, with a height equal to or greater than its diameter. Its warmth is chiefly imported to the point where its action begins, partly as sensible, partly as 'latent' heat; but, unlike the cyclone, its action ceases as soon as the original mass of warm air escapes upward through its warm cover. On apprehending these peculiarities, we may better appreciate its farther development.

The tornado has two motions to be considered, in addition to its general progression,— the spiral rotation, and the central updraught. The latter cannot, except under special conditions yet to be mentioned, become very rapid, for it depends primarily, simply on differences of temperature insufficient to produce very active motion; but the former attains a great velocity near the centre in virtue of the mechanical principle already quoted,—the 'preservation of areas.' When a whirling body is drawn toward the centre about which it swings, its velocity of rotation will increase as much as its radius of rotation decreases; the centrifugal force will also increase, and with the square of the velocity, or inversely as the square of the radius. This law claims obedience from air, as well as from solid bodies: hence, if the air of a tornado mass have a gentle rotary velocity of twenty or thirty feet a second at a thousand yards from the centre, this velocity will increase as the central air is drained away and the outer particles move inward; so that, when their radius is only one hundred yards, they will fly around at the rate of two or three hundred feet a second, or over one hundred and fifty miles an hour. It must be understood, however, that this requires that there should have been no loss of motion by friction, and hence can be true only for the air at a distance above the ground; and, further, that, in spite of the great horizontal rotary motion, there is still only a moderate vertical current. And consequently we have not yet arrived at the cause of the violent central and upward

winds that distinguish the tornado from other storms, but this cause is close at hand.

Admit for a moment that there is no friction between the air and the ground. We should then have a tall vertical cylinder of air, spinning around near the centre at a terrific speed, at the base as well as aloft, and consequently developing a great centrifugal force. As a result, the density of the central core of air must be greatly diminished. Most of the central air must be drawn out by friction into the whirling cylinder, and prevented from returning by the centrifugal force. The core will be left with a feeling of emptiness, like an imperfect vacuum. If there were any air near by not controlled by the centrifugal force, it would rush violently into the central core to fill it again. Now consider the effect of friction with the ground. The lowermost air is prevented from attaining the great rotary velocity of the upper parts, and consequently is much less under the control of the centrifugal force, which is measured by the square of the velocity. The surface-air is therefore just what is wanted to fill the incipient vacuum: so it rushes into the core and up through it with a velocity comparable to that of the whirling itself; and *this inward-rushing air is the destructive surface-blast of the tornado.*

This explanation, first proposed by Mr. Ferrel a few years ago, is most ingenious and satisfactory. Moreover, he has followed its several parts by close mathematical analysis, and shown that the moderate antecedent conditions are amply sufficient to account for all the violence of the observed results.

There are still several points to be considered. The whirling motion has been described as corresponding in nearly all cases with that of northern cyclones; and yet it cannot be supposed that the indraught winds of a tornado are drawn from sufficient distances to show the effect of the earth's deflective force: it is more probable that the tornado is to be regarded as a small whirl within a larger one, for the warm and cold winds are probably part of a large cyclonic system in which differential and rotary motions are established; and, when such winds form a small local whirl of their own, it will rotate in the same direction as they do, from right to left. For a like reason the planets rotate on their axes in the direction in which they revolve around the sun. The constant direction of rotation in tornadoes may therefore, by itself, be taken as evidence that their cause is not in a stagnant atmosphere, like that of the desert-whirls, but is connected with the conflicting currents of a large, gentle cyclone.

The progressive motion of the tornado-centre is so constant in its direction to the north-east or east, that it cannot depend on local conditions within itself, but must rather result from its bodily transportation by the prevailing winds, with which the tornado-tracks agree very well in direction and rate. It will last till the lower warm air, which constituted the original unstable mass, is exhausted. This generally happens in about an hour, when it has traversed a distance of nearly thirty miles.

The tornado thus constituted may be likened to a very active air-pump, carried along a few hundred feet above the ground, sucking up the air over which it passes. It is for this reason that the surface-winds are so nearly radial. For this reason an enclosed mass of air, as in a house, suddenly explodes as the vacuum is formed over it; and as the air rushes to the centre, and there expands and cools, its vapor becomes visible in the great funnel, or spout, pendent from the clouds above. No rain can fall at the centre. Bodies much heavier than rain are lifted there, instead of dropped: so the rain must rise through the central core, and fall to one side of the storm, or before or behind it. If the expansion be very great, and the altitude reached by the drops rather excessive, then they will be frozen to hailstones before falling. Hail-storms and tornadoes commonly go together: they mutually explain each other. Electricity has no important part to play in the disturbance.

It was stated under cyclones that their central barometric depression had two causes, — the overflow caused by the central warmth, and the dishing-out of the air by centrifugal force. The first of these is ordinarily regarded as the effective cause of the wind's inward blowing. It has already been pointed out that the second and greater part of the depression is also effective in drawing in the winds when friction decreases their rotary velocity. We may now call attention to a third cause of centripetal motion in the cyclone already alluded to, in which it is like the tornado. The upper winds move with great rapidity, and cause a strong barometric depression at the centre of their whirling; but at the base of the storm, where friction with the sea, or still more with the land, reduces the lower wind's motion, and so diminishes their centrifugal force, we may have an indraught of the tornado style, in which the centrifugal diminution of central pressure in the upper winds is an effective cause of centripetal motion in the lower winds. While this is not the principal cause of surface-

winds in a cyclone, it may be an important aid to central warmth.

Water-spouts are closely allied to tornadoes: but when seen in small form they approach the character of simple desert-whirls; that is, they then depend merely on air warmed at the place where they occur, and not on the running together of warm and cold winds from other regions. A probable cause for the excess of their strength above that of the sand-whirls lies in the smoothness of the water-surface on which they spring up, which will allow a long time of preparation; and in the moisture in the air, which will cause the warming of a greater thickness than if the air were very dry. The greater the thickness, the more their action will resemble that of a typical tornado. The appearance of the downward extension of the funnel-shaped cloud to meet the rising column of water is almost certainly only an appearance, and has the explanation already quoted from Franklin's ingenious writings.

We have relied largely, in the preceding explanations, on deductions from general principles, checked by the results of observation. The writings of many investigators have been examined, and in a few cases their names have been given; but the literature of the subject is now so extensive that full reference has been deemed unadvisable. Little attention has been paid to the older theories, in which conflicting winds and electricity were looked on as the chief causes of storms. The latter is regarded as an effect rather than a cause; and, while the former has much importance when rightly considered in connection with the earth's rotation, it is of small value as originally stated, and is then limited to the production of short-lived storms in mountainous districts. The more important factors of the modern theory of storms are the consideration of the conditions of stable and unstable equilibrium of the atmosphere, the true measure of the action of condensing water-vapor, the full estimation of the effect of the earth's rotation, and the recognition of the necessary increase in the wind's velocity as it is drawn in toward the storm-centre.

W. M. DAVIS.

THE CRITICAL STATE OF GASES.

THE *Philosophical magazine* for August, 1883, contains a letter from Dr. William Ramsay which refers to observations upon the critical state of gases, published in the Proceedings of the London royal society, 1879–80. The chief observations that had previously been made upon this interesting subject are those of Cagniard de la Tour (*Annales de chimie*, 2ème série, xxi. et xxii.), Faraday (*Phil. trans.*, 1823 and 1845), Thilorier (*Annales de chimie*, 2ème série, lx.), Natterer (*Pogg. ann.*, xciv.), Andrews (*Phil. trans.*, 1869). Andrews found that when a gas was compressed in a closed space, and was maintained at a temperature below a certain limit, the pressure of the gas increased up to a fixed point, beyond which condensation occurred. The pressure at which condensation takes place increases rapidly with the temperature of the gas. At and beyond a certain temperature — the critical temperature — no amount of pressure can produce any of the usual phenomena of condensation. The isothermal lines below the critical temperature are apparently discontinuous, one portion representing no change of pressure corresponding to a change of volume. Above the critical temperature the isothermals are continuous.

The experiments of Dr. Ramsay were made upon benzine and ether, and a mixture of equal weights of benzine and ether. In one experiment a closed glass tube, somewhat in the shape of an hourglass, was used. One end of the tube was partly filled with ether, and was heated in an inclined position. The liquid expanded until, at the moment the meniscus disappeared, it nearly filled the lower half of the tube. On cooling, the liquid all condensed in the lower half.

The experiment was varied by inverting the tube after the meniscus had disappeared. On cooling, the liquid condensed in the upper half of the tube. The tube was next maintained for some time at a temperature above that at which the meniscus disappeared. On cooling, an equal quantity condensed in each division of the tube. It was observed, that, after the meniscus had disappeared, the part of the tube containing liquid had a different index of refraction from the other part.

The conclusion to be drawn from these results is, that, at and above the critical point, the density of the liquid is the same as that of its saturated vapor: consequently, after a sufficient time, the liquid and its vapor will become mixed. Above the critical point, the surface tension of a liquid disappears.

This conclusion is confirmed by the experiments of M. Cailletet (*Comptes rendus*, Feb. 2, 1880). He found that when the lower part of his experimental tube was filled with liquid carbonic anhydride at a temperature of 5°.5, and the upper part was filled with air and gaseous carbonic anhydride, a pressure of a hundred and fifty to two hundred atmospheres was necessary to cause the liquid to mix with the gas. At the suggestion of Mr. Jamin (*Comptes rendus*, May 21, 1883), hydrogen was substituted for the air in the upper part of the tube, and it was then found that a greater pressure was necessary to produce the mixture. This result would necessarily follow if we suppose that the mixture takes place when the densities of the liquid and the gas become equal. We cannot say that the liquid is converted into gas by pressure.

Though the densities of a liquid and its saturated vapor are equal, above the critical point, the two states of matter are still distinguished by other physical properties. Their indices of refraction are differ-

ent: the liquid is capable of dissolving solids which are insoluble in the vapor. The latter fact is proved by the experiments of Hannay and Hogarth (*Proc. roy. soc.*, Oct., 1879), and also by similar experiments of Dr. Ramsay. A small piece of potassium iodide was placed in the lower part of the experimental tube, which was partly filled with anhydrous alcohol. The upper part of the tube was free from alcohol, but its sides were covered with a film of crystalline potassium iodide. When the tube was heated and the meniscus disappeared, the salt in the lower part of the tube was dissolved, while that in the upper part remained unchanged. Similar observations were made on eosine.

Dr. Ramsay's second paper contains the isothermal lines for benzine, ether, and a mixture of benzine and ether, below and above the critical temperatures. The apparatus used resembled that of Andrews. The most remarkable feature of these lines is, that, below the critical temperature for benzine, there appears to be a diminution of pressure corresponding to a diminution of volume, immediately before complete condensation takes place. This phenomenon appears very slightly in a mixture of benzine and ether, but is not apparent in ether alone. It has been suggested by James Thomson (*Proc. roy. soc.*, 1871) that the isothermals for all gases might have somewhat this form below the critical temperature. Dr. Ramsay explains the fact by supposing that the molecules, when the gas has been compressed to a certain extent, begin to exert mutual attraction and relieve the pressure. The fact may be connected with the observed phenomenon that the meniscus of benzine remains easily distinguishable until it vanishes, whereas the meniscus of ether soon becomes hazy. At the part of the isothermal under consideration the substance is evidently in a condition of unstable equilibrium, and it is difficult to see how this part of the curve could have been detected experimentally.

The critical temperature and pressure of a mixture of benzine and ether were found to be not far removed from the mean of the critical temperatures and pressures of the components.

No direct experiments have yet been made to ascertain whether heat is evolved when a gas is converted into liquid by pressure at temperatures above its critical temperature. Mr. Jamin concludes that at and beyond the critical point there is no latent heat. This conclusion, however, does not seem probable; since the molecular constitution of a liquid and its vapor are probably different, even above the critical temperature.

The conclusions which Ramsay draws from his experiments are summed up as follows: —

"1°. A gas may be defined as a body whose molecules are composed of a small number of atoms.

"2°. A liquid may be regarded as formed of aggregates of gaseous molecules, forming a more complex molecule.

"3°. Above the critical point, the matter may consist wholly of gas if a sufficient volume be allowed, wholly of liquid if the volume be sufficiently diminished, or of a mixture of both at intermediate volumes. That mixture is, physically speaking, homogeneous in the same sense as a mixture of oxygen and hydrogen gases may be termed homogeneous."

C. B. PENROSE.

COLORED SKIES AFTER AN ERUPTION OF COTOPAXI.[1]

THE remarkable sunsets which have been recently witnessed upon several occasions have brought to my recollection the still more remarkable effects which I witnessed in 1880 in South America, during an eruption of Cotopaxi; and a perusal of your highly interesting letter in the *Times* of the 8th inst. has caused me to turn to my notes, with the result of finding that in several points they appear to have some bearing upon the matter which you have brought before the public.

On July 3, 1880, I was engaged in an ascent of Chimborazo, and was encamped on its western side at 15,800 feet above the sea. The morning was fine, and all the surrounding country was free from mist. Before sunrise we saw to our north the great peak of Illiniza, and twenty miles to its east, the greater cone of Cotopaxi; both without a cloud around them, and the latter without any smoke issuing from its crater, — a most unusual circumstance: indeed, this was the only occasion on which we noticed the crater free from smoke during the whole of our stay in Ecuador. Cotopaxi, it should be said, lies about forty-five miles south of the equator, and was distant from us sixty-five miles.

We had left our camp, and had proceeded several hundred feet upwards, being then more than 16,000 feet above the sea, when we observed the commencement of an eruption of Cotopaxi. At 5.45 A.M. a column of smoke of inky blackness began to rise from the crater. It went up straight in the air, rapidly curling, with prodigious velocity, and in less than a minute had risen 20,000 feet above the rim of the crater. I had ascended Cotopaxi some months earlier, and had found that its height was 19,600 feet. We knew that we saw from our station the upper 10,000 feet of the volcano, and I estimated the height of the column of smoke at double the height of the portion seen of the mountain. The top of the column was therefore nearly 40,000 feet above the sea. At that elevation it encountered a powerful wind blowing from the east, and was rapidly borne for twenty miles towards the Pacific, seeming to spread very slightly, and remaining of inky blackness, presenting the appearance of a gigantic inverted ⌊_ drawn upon an otherwise perfectly clear sky. It was then caught by a wind blowing from the north, and was borne towards us, and appeared to spread rapidly in all directions. As this cloud came nearer and nearer, so, of course, it seemed to rise higher and higher in the sky, although it was actually descending. Several hours passed before the ash commenced to intervene between the sun and ourselves; and, when it did so, we witnessed effects which simply amazed us. We saw a green sun, and

[1] From *Nature*, Dec. 27. A letter sent to Mr. Norman Lockyer.

such a green as we have never, either before or since, seen in the heavens. We saw patches or smears of something like verdigris-green in the sky; and they changed to equally extreme blood-reds, or to coarse brick-dust reds, and they in an instant passed to the color of tarnished copper or shining brass. Had we not known that these effects were due to the passage of the ash, we might well have been filled with dread instead of amazement; for no words can convey the faintest idea of the impressive appearance of these strange colors in the sky, seen one minute and gone the next, resembling nothing to which they can be properly compared, and surpassing in vivid intensity the wildest effects of the most gorgeous sunsets.

The ash commenced to pass overhead at about midday. It had travelled (including its détour to the west) eighty-five miles in a little more than six hours. At 1.30 it commenced to fall on the summit of Chimborazo, and, before we began to descend, it caused the snowy summit to look like a ploughed field. The ash was extraordinarily fine, as you will perceive by the sample I send you. It filled our eyes and nostrils, rendered eating and drinking impossible, and reduced us to breathing through handkerchiefs. It penetrated everywhere, got into the working-parts of instruments and into locked boxes. The barometer employed on the summit was coated with it, and so remains until this day. That which ssed beyond us must have been finer still. It travelled far to our south, and also fell heavily upon ships on the Pacific. I find that the finer particles do not weigh the twenty-five thousandth part of a grain, and the finest atoms are lighter still. By the time we returned to our encampment, the grosser particles had fallen below our level, and were settling down into the valley of the Chimbo, the bottom of which was 7,000 feet beneath us, causing it to appear as if filled with thick smoke. The finer ones were still floating in the air, like a light fog, and so continued until night closed in.

In conclusion, I would say that the terms which I have employed to designate the colors which were seen are both inadequate and inexact. The most striking features of the colors which were displayed were their extraordinary strength, their extreme coarseness, and their dissimilarity from any tints or tones ever seen in the sky, even during sunrises and sunsets of exceptional brilliancy. They were unlike colors for which there are recognized terms. They commenced to be seen when the ash began to pass between the sun and ourselves, and were not seen previously. The changes from one hue to another, to which I have alluded, had obvious connection with the varying densities of the clouds of ash that passed; which, when they approached us, spread irregularly, and were sometimes thick and sometimes light. No colors were seen after the clouds of ash passed overhead and surrounded us on all sides.

I photographed my party on the summit of Chimborazo whilst the ash was commencing to fall, blackening the snow-furrows; and, although the negative is as bad as might be expected, it forms an interesting souvenir of a remarkable occasion.

Edward Whymper.

MODERN PHYSIOLOGICAL LABORATORIES: WHAT THEY ARE AND WHY THEY ARE.[1] — II.

We have seen that Haller laid the foundation of the knowledge that the body of one of the higher animals was essentially an aggregation of many organs, each having a sort of life of its own, and in health coöperating harmoniously with others for the common good. In the early part of this century, before scientific thought had freed itself from mediaeval guidance, this doctrine sometimes took fantastic forms. For example: a school arose which taught that each organ represented some one of the lower animals. DuBois-Reymond relates that in 1838 he took down these notes at the lectures of the professor of anthropology: —

> "Each organ of the human body answers to a definite animal, is an animal. For example, the freely movable, moist, and slippery tongue is a cuttlefish. The bone of the tongue is attached to no other bone in the skeleton; but the cuttlefish has only one bone, and consequently this bone is attached to no other. It follows that the tongue is a cuttlefish."

However, while Professor Steffens and his fellow-transcendentalists were theorizing about organs, others were at work studying their structure; and a great step forward was made in the first year of our century by the publication of Bichat's 'Anatomie générale.' Bichat showed that the organs of the body were not the ultimate living units, but were made up of a number of different interwoven textures, or *tissues*, each having vital properties of its own. This discovery paved the way for Schwann and Schleiden, who laid the foundation of the cell-theory, and showed, that, in fundamental structure, animals and plants are alike, the tissues of each being essentially made up of aggregates of more or less modified microscopic living units called cells. Our own generation has seen the completion of this doctrine by the demonstration that the essential constituent of the cell is a peculiar form of matter named protoplasm, and that all the essential phenomena of life can be manifested by microscopic lumps of this material; that they can move, feed, assimilate, grow, and multiply; and still further, that, wherever we find any characteristic vital activity, we find some variety of protoplasm. Physiology thus became reduced, in its most general terms, to a study of the faculties of protoplasm; and morphology, to a study of the forms which units or aggregates of units of protoplasm, or their products, might assume. The isolation of botany, zoölogy, and physiology, which was threatened through the increased division of labor, brought about by increase of knowledge, necessitating a limitation of special study to some one field of biology, was averted; and the reason was given for that principle which we have always insisted upon here, — that beginners shall be taught the broad general laws of living matter before they are permitted to engage in the special study of one department of biology.

If I be asked, what have biological science in general, and physiology in particular, done for mankind

[1] Concluded from No. 50. Address by Dr. H. Newell Martin.

to justify the time and money spent on them during the past fifty years, I confess I think it a perfectly fair question; and fortunately it is one very easy to answer. Leaving aside the fruitful, practical applications of biological knowledge to agriculture and sanitation, I will confine myself to immediate applications of the biological sciences to the advance of the theory, and, as a consequence, of the art, of medicine.

So long as the life of a man was believed to be an external something apart from his body, residing in it for a while, diseases were naturally regarded as similar extrinsic essences or entities, which invade the body from without, and fought the 'vital force.' The business of the physician was to drive out the invader without expelling the vital spirits along with it, — an unfortunate result, which only too often happened. To the physicians of the sixteenth century a fever was some mysterious, extraneous thing, to be bled, or sweated, or starved out of the body, much as the medicine men of savages try to scare it off by beating tomtoms around the patient. Once life was recognized as the sum total of the properties of the organs composing the body, such a theory of disease became untenable, and the basis of modern pathology was laid. Disease was no longer a spiritual, indivisible essence, but the result of change in the structure of some one or more of the material constituents of the body, leading to abnormal activity. The object of the physician became, not to expel an imaginary, immaterial enemy, but to restore the altered constituent to its normal condition.

The next great debt which medicine owes to biology is the establishment of the cell-doctrine, — of the fact that the body of each one of us is made up of millions of little living units, each with its own properties, and each in health doing its own business in a certain way, under certain conditions, and no one cell more the seat of life than any other. The activities of certain cells may, indeed, be more fundamentally important to the maintenance of the general life of the whole aggregate than that of others; but these cells, which, by position or function, are more essential than the rest, were, in final analysis, no more alive than they. Before the acceptance of the cell-doctrine, pathologists were practically divided into two camps, — those who believed that all disease was primarily due to changes in the nervous system, and those who ascribed it to alteration of the blood. But with the publication of Virchow's 'Cellular pathology' all this was changed. Physicians recognized that the blood and nerves might at the outset be all right, and yet disease originate from abnormal growth or action of the cells of various organs. This new pathology, like the older, was for a time carried to excess. We now know that there may be general diseases primarily due to changes in the nervous system, which binds into a solidarity the organs of the body, or of the blood, which nourishes all; but we have also gained the knowledge that very many, if not the majority, of diseases have a local origin, due to local causes, which must be discovered if the disease is to be successfully combated. An engineer, if he find his machinery running imperfectly, may endeavor to overcome this by building a bigger fire in his furnace, and loading the safety-valve. In other words, he may attribute the defect to general causes; and in so far he would resemble the old pathologists. But the skilled engineer would do something different. If he found his machinery going badly, he would not jump forthwith to the conclusion that it was the fault of the furnace, but would examine every bearing and pivot in his machinery, and, only when he found these all in good working-order, begin to think the defect lay in the furnace or boiler; and in that he would resemble the modern physician instructed in the cell-doctrine.

A third contribution of biology to medical science is the germ-theory as to the causation of a certain group of diseases. To it we owe already antiseptic surgery; and we are all now holding our breath in the fervent expectation that in the near future, by its light, we may be able to fight scarlet-fever, diphtheria, and phthisis, not in the bodies of those we love, but in the breeding-places, in dirt and darkness, of certain microscopic plants.

From one point of view the germ-theory may seem a return to the idea that diseases are external entities which attack the body; but note the difference between this form of the doctrine and the ancient. We are no longer dealing with immaterial, intangible hypothetic *somethings*; and the modern practitioner says, "Well, show me the bacteria, and then prove that they can cause the disease: until you can do that, do not bother me about them."

It is worth while, in passing, to note that these three great advances in medical thought were brought about by researches made without any reference to medicine. Haller's purely physiological research into the properties of muscles laid the foundation of a rational conception of disease. The researches of Schwann on the microscopic structure of plants, and since then of others on the structure of the lowest animals, led to the cellular pathology. Antiseptic surgery is based on researches carried out for the sole purpose of investigating the question as to spontaneous generation. My friend Dr. Billings has described "the languid scientific swell, who thinks it bad style to be practical, and who makes it a point to refrain from any investigations which lead to useful results, lest he might be confounded with mere practical men." Well, I am sorry for the swell; because, for the life of me, I cannot see how he can make any investigations at all. The members of his class must anyhow be so few in number that we need not much grieve over them. Personally I never have met with an investigator who would not be rejoiced to find any truth discovered by him put to practical use; and I feel sure that in this day and generation the danger is rather that disproportionate attention will be devoted to practical applications of discoveries already made, to the exclusion of the search for new truth. So far as physiology is concerned, it has done far more for practical medicine, since it began its own independent career, than when it was a mere branch of the medical curriculum. All the history of the physical sciences shows that each of them has con-

tributed to the happiness and welfare of mankind in proportion as it has been pursued by its own methods, for its own ends, by its own disciples. As regards physiology, this is strikingly illustrated by a comparison of the value to medicine of the graduation theses of Parisian and German medical students. As probably you all know, a candidate for the doctorate of medicine in those countries, as in many schools here, must present a graduation thesis on some subject connected with his studies. Every year a certain number select a physiological topic. The French student usually picks out some problem which appears to have a direct bearing on the diagnosis or treatment of disease, while the German very often takes up some physiological matter which on the surface has nothing to do with medicine. Now, any one who will carefully compare for a series of years the graduation theses in physiology, of German and French candidates, will discover that even the special practical art of medicine itself is to-day far more indebted to the purely scientific researches of the German students than to those of the French, undertaken with a specific practical end in view. Situated as we shall be here, in close relation to a medical school, and yet not a part of it, I believe we shall be under the best possible conditions for work. Not under too direct pressure of the influence of the professional staff and students, on the one hand, on the other we shall be kept informed and on the alert as to problems in medicine capable of solution by physiological methods.

I must find time to say a few words as to the connection of physiology with pathology and therapeutics. The business of the physiologist being to gain a thorough knowledge of the properties and functions of every tissue and organ of the body, he has always had for his own purposes to place these tissues under abnormal conditions. To know what a muscle or a gland is, he has to study it not merely in its normal condition, but when heated or cooled, supplied with oxygen or deprived of it, inflamed or starved, and see how it behaves under the influence of curari, atropine, and other drugs. From the very start of physiological laboratories, a good deal of the work done in them has necessarily been really experimental pathology and experimental therapeutics. I suppose to-day that at least half of the work published from physiological laboratories might be classed under one or other of these heads. And what has been the fruit? I can here refer only to one or two examples. It is not too much to say, that, though inflammation is the commonest and earliest recognized of pathological states, we really knew nothing about it until the experimental researches of Lister, Virchow, and Cohnheim; and that all we really know as to the nature of fever is built on the similar researches of Bernard, Haidenhain, Wood, and others. As to therapeutics, so far as giving doses of medicine is concerned, it, still in its very infancy, had its birth as an exact science in physiological laboratories. Every modern text-book on the subject gives an account of the physiological action of each drug. What the future may have in store for us by pursuit of these inquiries it is hard to limit. The work of Bernard, — showing that in curari we had a drug that would pick out of the whole body, and act upon, one special set of tissues, the endings of the nerve-fibres in muscle, — and the results of subsequent exact experiments as to the precise action of many drugs upon individual organs or tissues, hold out before us a hope that perhaps at no very distant day the physician will know exactly, and in detail, what every drug he puts into his patient is going to do in him.

Pathology and therapeutics, while almost essential branches of physiological inquiry, have nevertheless their own special aims; and, now that the physiologists have proved that it is possible to study these subjects experimentally, special laboratories for their pursuit are being erected in Germany, France, and England. These laboratories are stocked with physiological instruments, and carry on their work by physiological methods. Those who guide them, and those who work in them, must be trained physiologists: if not, the whole business often degenerates into a mere slicing of tumors and putting up of pickled deformities: pathological anatomy is a very good and important thing in itself, but it is not *pathology*. Looking at the vast field of pathological and therapeutic research open to us, and bearing in mind the certainty of the rich harvest for mankind which will reward those who work on it, I regard as one of my chief duties here to prepare in sound physiological doctrine, and a knowledge of the methods of experiment, students who will afterwards enter laboratories of experimental pathology and pharmacology immediately connected with our medical school.

If the relations of the biological sciences to medicine be such as I have endeavored to point out, what place should they occupy in the medical curriculum? That men fitted for research, and with opportunity to pursue it, should be trained to that end, is all well and good; but how about the ninety per cent who want simply to become good practitioners of medicine? What relation is this laboratory to hold to such men, who may come to it, intending afterwards to enter a medical school? As a part of their general college-training, of that education of a gentleman which every physician should possess, it should give them specially a thorough training in the general laws which govern living matter, without troubling them with the minutiae of systematic zoölogy or botany; it should enable them to learn how to dissect, and make them well acquainted with the anatomy of, one of the higher animals; it should teach them how to use a miscroscope, and the technique of histology, and finally, by lectures, demonstration, and experiment, make known to them the broad facts of physiology, the means by which those facts have been ascertained, and the sort of basis on which they rest. The man so trained, while obtaining the mental culture which he would gain from the study of any other science, is specially equipped for the study of medicine. Trained in other parts of his general collegiate course to speak and write his own language correctly, having acquired a fair knowledge of mathematics and Latin, able to read at least French and German, having learned the

elements of physics and chemistry, and, in addition, having studied the structure and properties of the healthy body, he can, on entering the technical school, from the very first turn his attention to professional details. Knowing already the anatomy of a cat or dog, he knows a great part of human anatomy, and need do little but acquaint himself with the surgical and medical anatomy of certain regions. Knowing normal histology, he can at once turn his attention to the microscopy of diseased tissues. Well instructed in physiology, he can devote himself to its practical applications in the diagnosis and treatment of disease. The demand for an improvement in medical education, which has been so loudly heard in England and this country for some years, is (the more I think of it, the more I feel assured) to be met, not, as has been the case in England, by putting more general science into the medical-school curriculum, but by confining *that* more strictly to purely professional training, and by providing, as we have attempted to do here, non-technical college-courses for undergraduates, which, while giving them a liberal education, shall also have a distinct relation to their future work. Personally I regard it as the most important of my duties, to prepare students to enter medical schools in this city or elsewhere.

To advance our knowledge of the laws of life and health; to inquire into the phenomena and causes of disease; to train experimenters in pathology, therapeutics, and sanitary science; to fit men to undertake the study of the *art* of medicine, — these are the main objects of our laboratory. I do not know that they can be better summed up than in the words of Descartes, which I would like to see engraved over its portal: "If there is any means of getting a medical theory based on infallible demonstrations, that is what I am now inquiring."

THE CLOSING REPORT OF HAYDEN'S SURVEY.

Twelfth annual report of the U. S. geological and geographical survey of the territories: a report of progress of the exploration in Wyoming and Idaho for the year 1878. Washington, *Government printing-office*, 1883. 2 vols. 8°. With portfolio of maps and panoramas.

IN two stout octavo volumes, with an accompanying portfolio of maps, Dr. Hayden presents the twelfth and last annual report of the Geological survey of the territories. While the late reorganization and consolidation of the surveys which have been occupied in the scientific exploration of the west is indubitably a very marked step in advance, it is not without a measure of regret that we realize that Dr. Hayden's familiar and always welcome annual report now reaches us for the last time. It is perhaps only those having some experience of similar work who can fully appreciate the energy and maintained scientific enthusiasm necessary for the conduct of an organization such as that which under Dr. Hayden has built so broad a foundation for our geological knowledge of the western part of the continent.

The volumes now issued constitute the report for 1878, the concluding season of field-work. Great care has evidently been given to the editing and printing of the report; and the number and good quality of the illustrations and maps are noteworthy features. Of plates alone, in the two volumes, there are over two hundred and fifty; and most of them are excellent specimens of lithographic art.

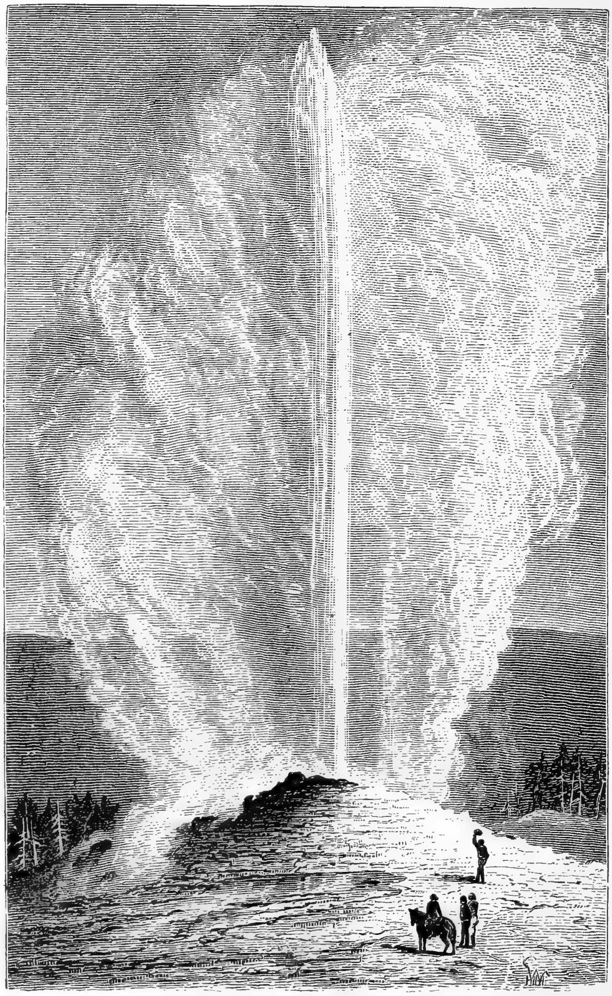
The first volume is devoted chiefly to paleontology and zoölogy, while the second may be regarded as a memoir on the Yellowstone national park. Dr. C. A. White, in his report, under the title of 'Contributions to invertebrate paleontology, No. 2,' presents the second part of his descriptions and illustrations of cretaceous fossils. This is followed (as parts 4 to 8 of the contributions) by papers on tertiary, Laramie, Jurassic, triassic, and carboniferous fossils. The article on the Laramie, including, besides the descriptions and plates of a number of forms, a systematic enumeration of the invertebrate fossils of the group, assumes the character of a synopsis of its fauna invaluable to the student of this period of geological history. Mr. Orestes St. John's very comprehensive and systematic report on the Wind River district could be done justice to only in a separate note of some length.

Mr. S. H. Scudder's report on the tertiary lake-basin of Florissant is next in order. From this place a number of fossil plants and a few fishes and birds have been obtained: but it is specially remarkable for the wonderfully numerous remains of insects which it affords; "having yielded in a single summer more than double the number of specimens which the famous localities at Oeningen, in Bavaria, furnished Heer in thirty years." The fossils occur in fine-grained volcanic ash-beds, which, together with coarser materials of the same origin, constitute the deposits of the old lake-basin. The age of the beds is apparently about that of the oligocene, and the climatic conditions may have resembled those of the northern shores of the Gulf of Mexico at the present day. A complete description of the insects will be awaited with much interest. Mr. Packard's monograph of the phyllopod Crustacea of North America, having been already noticed in *Science*,[1] need only be mentioned. In the latter part of the first volume, Dr. R. W. Shufeldt treats of the osteology of the Cathartidae

[1] Vol. ii. p. 571.

and North-American Tetraonidae, the burrowing owl, horned lark, and shrike.

On the Yellowstone national park, or reservation as it may perhaps more fitly be called, much has already been written, both of a scientific and popular character; but the second volume of the present report is the first proximately complete account of its physical and geological features. The first scientific exploration of this wonderful region was that of the survey of the territories in 1871 and 1872; and it is largely due to the personal efforts of Dr. Hayden that the district was set apart as a national park. Though reports more or less garbled, of its geysers and hot-springs, were from an early period in circulation in the west, they were not generally credited; and it is a remarkable fact, that this region, in the midst of so much active exploration of the west, continued so long practically unknown. It remained for the ubiquitous western 'prospector' to afford some intelligible account of its character between 1863 and 1869; and Dr. Hayden's first exploration followed not long thereafter.



OLD FAITHFUL GEYSER IN ACTION, 1871.

The reservation is situated mainly in north-western Wyoming, but embraces also portions of Idaho and Montana. It is about 65 by 53 miles in extent, with a computed area of 3,312 square miles, of which nearly 200 square miles are occupied by lakes. To the north and east are bounding ranges of lofty and rugged mountains; but, apart from the cañons of the rivers, the region itself does not abound in grand scenery, consisting chiefly of high rolling plateaus covered with dark coniferous forest, but, along the borders of the streams, opening out into the attractive park-like country characteristic elsewhere of many of the sub-alpine valleys of the Rocky Mountains. The mean elevation, being about eight thousand feet, renders it subject to frosts throughout the summer, and quite unfit for agriculture: indeed, the frequent reference to snow-storms as interfering with the operations of 1878 would alone be sufficient to indicate the sub-arctic character of the climate.

The geology of the park is reported on by Mr. W. H. Holmes, who carries with him throughout a clear appreciation of the bearing of observed facts on the causes and history of the remarkable events of which this portion of the 'great divide' has been the theatre. While most of the formations known in the north-west are represented in the park, a glance at the map shows that those of volcanic origin cover by far the greatest area; and it is in connection with these that its special features have been developed. Volcanic conglomerates of tertiary age are particularly prominent, and attain in some places a very great thickness. Rhyolite preponderates, but basalts also frequently occur; and the existence of large masses of obsidian or volcanic glass is a point both of mineralogical, and, from the use made of it by the Indians, ethnological interest.

From the deeply eroded valley of the Yellowstone, almost all the facts as to the pre-tertiary history of the park are drawn; and the line of this river appears to have been determined by a great fault for which a minimum estimate of the displacement is given at 15,000 feet. This fault was probably synchronous with the general Rocky Mountain uplift, and is presumed to be in more or less direct causal connection with the subsequent remarkable history of the district. It is not a simple fissure, but a break along which the edges of the strata have been much dragged and contorted, particularly on the dropped side; appearing, in fact, to have the character of a great flexure pushed to fracture. On its northern side rises the Yellowstone Range; while to the south, in the depressed area, are found the evidences of that prodigious volcanic activity of which the actual thermal phenomena are the last lingering stages.

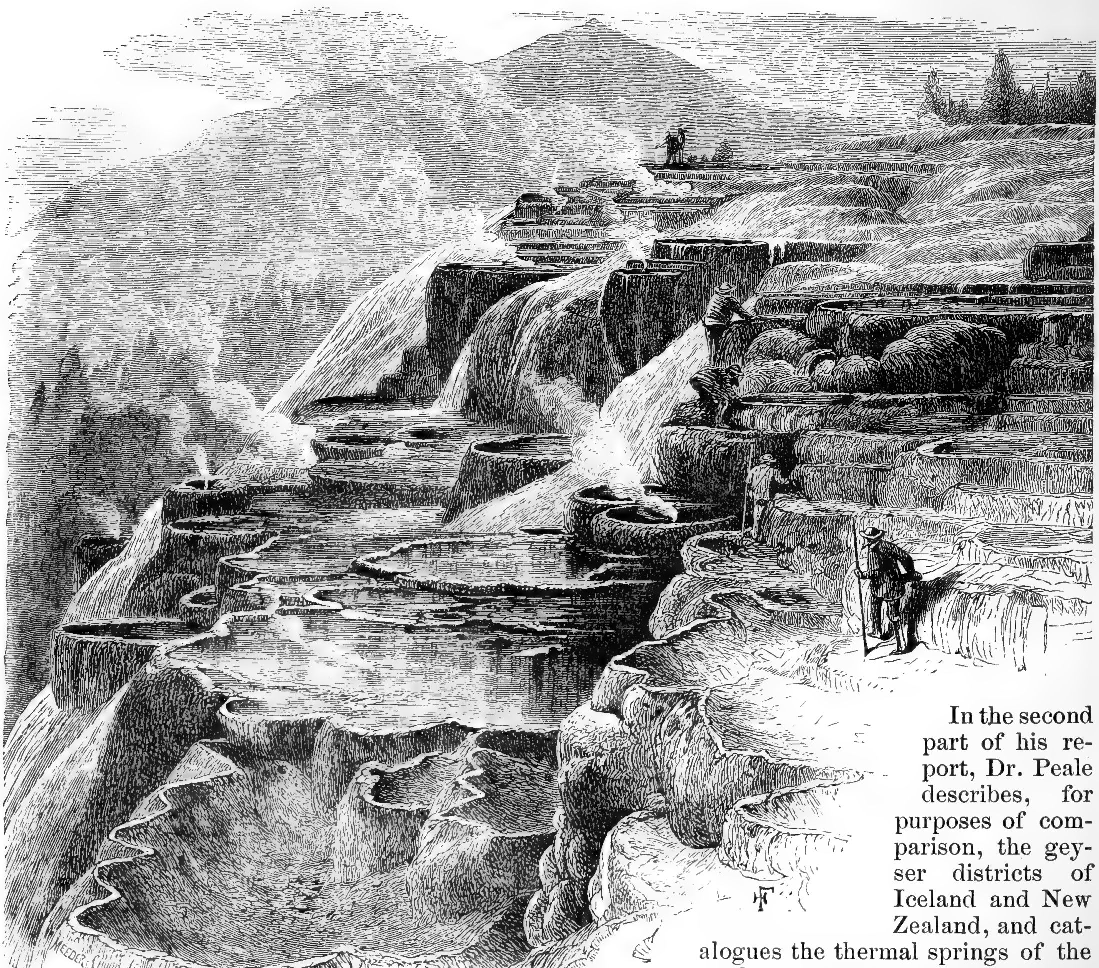
From the older tertiary rocks of the park have been collected a number of plants which Professor Lesquereux refers to the Fort Union group; but, before the inauguration of the volcanic periods, these beds, together with the paleozoic rocks, had been deeply scored by erosion. The earlier flows of trachyte and rhyolite poured into the then existing valleys till they were, in many cases at least, entirely obliterated, and the successors of these first rivers forced to cut new channels having little or no reference to the position of the old. Subsequent lava-flows again filled these later valleys, and, through the succeeding basaltic and conglomeritic epochs of activity, this process appears to have been repeated many times. The entire period of volcanic activity must have been of extremely long duration, and may have lasted through a great part of the tertiary. From the volcanic conglomerates of Amethyst Mountain, plants of upper miocene or lower pliocene age have been identified. Very much yet remains, however, to be discovered in the history of this prolonged period, which, in its succession of volcanic outbursts alternating with epochs of quiet river-work, much resembles that of the classic tertiary volcanic region of central France, and may, when fully disclosed, tell as interesting a story. In Amethyst Mountain some of the latest stages are well exemplified, and we have, perhaps, the finest series of buried erect forests ever discovered. The volcanic rocks, here characteristically conglomeritic, show a thickness of five thousand feet, and are charged almost throughout with the silicified remains of ancient forests. The lower layers are comparatively fine grained, but are followed by conglomerates which become coarser and more breccia-like in ascending, but are throughout interbedded with sandstones, and shaly layers largely tufaceous in character, and appear to be partly water-bedded and partly sub-aerial. The intervals between successive eruptions have been sufficient to allow the surface to become clothed again and again by a heavy forest-growth, each of which has been destroyed and buried in turn.

GRAND CAÑON OF THE YELLOWSTONE.

There can be little doubt that the hot-springs have been continuously in existence since the volcanic period; and actual evidence of their great antiquity is found in the occurrence of fragments of the characteristic calcareous deposit in some of the higher river-terraces, since the formation of which the Yellowstone has cut for itself a cañon a thousand feet in depth.

For an account of the hot-springs and geysers as found at the present day, we must, however, turn to the second section of the report, in which Dr. Peale treats the subject in an exhaustive manner, tabulating over two thousand springs and seventy-one

geysers. The springs show some evidence of linear arrangement, but dispose themselves for purposes of investigation in a series of groups, which are systematically described, mapped, and illustrated. The eruptions of the principal geysers are tabulated with the purpose of investigating the regularity, or otherwise, of the eruption periods ; and, in collecting and reviewing all that has already been observed on this point, Dr. Peale has had by no means a light task. So many accounts have already appeared of the more remarkable geysers and springs, that their main features have become more or less familiar to all, in so far as they can be made so by description. The Giant, Castle, Grand, Old Faithful, Giantess, Bee-Hive, and others of the best known geysers, are included in the upper geyser basin of the Fire-Hole River; and the flow of heated water is here so great as to notably affect the temperature of the stream itself. In this area alone, not quite four square miles in extent, 440 springs are known, of which 26 are veritable geysers, some, during these paroxysms of eruption, producing columns of 150 to 250 feet in height.



BASINS AT MAMMOTH HOT-SPRINGS OF GARDINER'S RIVER.

In the second part of his report, Dr. Peale describes, for purposes of comparison, the geyser districts of Iceland and New Zealand, and catalogues the thermal springs of the world. In the third, under the title of 'Therma-hydrology,' the general features of hot-springs are discussed : their physical and thermal conditions, formations and deposits, and geyseric phenomena, are reviewed, bringing out many points of interest. The geysers of all parts of the world are essentially similar in character. Those of the park are remarkable for the development of chimneys, or cones, at their orifices, — a fact attributed to the greater antiquity of the now existing vents, but which, it appears

equally probable, may arise from the greater dryness of air in the park region as compared with that of Iceland and New Zealand.

The chemical investigation of the Yellowstone springs is not yet sufficiently complete for their satisfactory classification; but they are broadly divided by Dr. Peale into those of calcareous, siliceous, and aluminous character. The so-called aluminous springs, being those highly charged with mud, or matter in a state of suspension, will doubtless eventually be relegated to one or other of the first-named classes. The possible therapeutical value of the springs is as yet practically untested; and it is to be remarked in this connection, that the climate is such as in any event to be unfavorable to those suffering from debilitating diseases. A few experiments on the color of the waters are recorded; but these, it must be confessed, are unsatisfactory, as the samples had been long in bottle; and, apart from this, it is doubtful whether the waters of the park offer peculiarities so marked as to throw any important light on a subject which has already been elaborately studied by physicists and chemists.

The older theory of geyser action requiring a steam-chamber which blew off, from time to time, through a water-trap connecting with a tubular orifice, and implying a quite exceptional co-ordination of circumstances, became virtually untenable when geysers were discovered in such considerable numbers in different regions. Bunsen's explanation, depending on the superheating of water under pressure in fissures, or more or less tubular receptacles, seriously modified in action by local circumstances, is considered sufficient to account for the observed phenomena.

Appended to this report, is a valuable bibliography of the park, and of the literature treating of geysers and hot-springs generally.

In the latter part of the volume, Mr. Gannett reviews the geographical work on which the excellent maps accompanying the report are based.

Notwithstanding the amount of precise information now made available on this region, much yet evidently remains to be discovered. The field-work on which the report on the park is based extended over about two months only; and the observations have too often been of what Mr. Holmes regretfully describes as the 'twenty-five-mile-a-day kind.' Armed with the present report, embodying the results so far obtained, each scientific visitor for a long time to come may well hope to add some important new facts. The definition of the catchment areas from which the various groups of springs are supplied, and the circulation of the underground waters, may be specially noted as an important point scarcely yet touched.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Princeton science club.

Nov. 8.—Dr. L. W. McCay reported that the Perrot method for estimating P_2O_5 can only give accurate results providing chlorine be absent. This, however, is seldom the case in apatites, superphosphates, etc. He therefore proposes a modification,—dissolving the tri-argentic phosphate from the filter-paper with dilute nitric acid, thereby leaving the chloride, and proceeding at once to titrate the silver according to Vallhardt. He reserves for himself the privilege of developing the subject.

Jan. 10.—Dr. Halsted opened a discussion as to whether Euclid was a suitable text-book for elementary geometrical instruction;—Mr. Fine read a paper on Synthetic solution of a class of problems in maxima and minima on the partition of a segment of a circle;—Professor Macloskie, Notes on biological articles in recent scientific serials;—Dr. McCay, Analysis of beer made in state of New Jersey;—Mr. McNeill, Determination of co-ordinates of certain stars by the meridian circle;—Professor Scott, The lamprey (the peculiar flattened shape of the spinal cord in the lamprey arises late in larval life, and is an acquired peculiarity. In the embryo the dorsal roots of the spinal nerves are all connected by a commissure, which also connects the tenth, ninth, and seventh nerves together, and with the spinal nerves. This commissure apparently forms the lateral nerve. The third nerve arises independently, and would seem to be of segmental value);—Professor Osborn, A method of double injection of anatomical specimens (by first injecting the veins through the arteries with blue gelatine, then injecting the arteries with plaster of paris, which is stopped at the capillaries, the veins and arteries can be readily distinguished);—Professor Young, The cause of the unusual sunsets, On the spectrum of the Pons-Brooks comet.

Ottawa field-naturalists' club.

Jan. 17.—The paper of the evening was by Mr. E. Odlum, M.A., of Pembroke, 'On the sand-plains and changes of water-level of the Upper Ottawa;' the portion of the river specially referred to being a stretch of some forty miles opposite the town of Pembroke, and extending from the head of the Coulonge Lake to the entrance of the reach known as the Deep

River. The district thus included lies along latitude 45° 50′, between longitudes 76° 40′ and 77° 40′; the town of Pembroke being 77° 10′, with an elevation above sea-level of 423 feet. At the upper end of the district the Ottawa divides its waters, and encircles the large Allumette Island; the Culbute Channel on the north being narrow, while the southern one expands so as to be known as the Upper and Lower Allumette Lakes. On the Quebec shore the land rises precipitously; the Laurentian Mountains seldom receding more than a mile, and at times rising sheer from the water's edge in towering cliffs of trap. On the Ontario side the land is comparatively undulating, and rises by a succession of plateaus separated by ridges of rock, or by ranges of hills gradually increasing in height. After a graphic description of the beauties of this district, the writer outlined the principal sand-plains which constitute a large portion of the steppes of the southern shore, and pointed out that their levels coincided with the well-marked terraces found on Allumette Island and at other points along the river. The formation of these sand-plains was then fully discussed; and it was claimed that they had undoubtedly been formed from the *débris* transported by flowing water from the rock ranges that bound and intersect them, and toward which the surface gradually changes from fine sand (or occasionally clay), through coarser sands, pebbles, etc., to bowlders. The principal plain is that called the Chalk-river sand-plain, extending from near Pembroke, twenty miles westward. It is interrupted toward the lower end by broken ridges, which harmonize in position with the rapids, and which formed parts of barriers between a higher level westward and a lower level eastward. Occasional sand-ridges occur, which lie between the ancient mouths of rivers, of which some are now extinct, and others, as the Petawawa and Muskrat, still flow in greatly diminished volume. The two principal levels of this plain correspond with two terraces boldly marked on the Laurentians near the head of Coulonge Lake, fully thirty miles away. A lake as large as, or larger than, Superior must in the past have hidden in its great depths Allumette Island, the entire Pembroke district, and adjacent sand-plains, as well as thousands of the now arable acres lying toward Renfrew. As indicated by the terraces, there had been two distinct periods, in the first of which the water had been 200 feet deeper, and in the second 100 feet deeper, than the present level. After describing the constitution of the soils derived respectively from the granite or trap ridges, and their relative capacities for agriculture, the writer very lucidly and interestingly explained the changes, as witnessed by him, which are still going on in the district, and the manner in which, by the incessant weathering and denudation of the rocks, sand-plains on a smaller scale are still being formed. The present barriers which cause the rapids interrupting navigation were explained to be of varying degrees of hardness, so that change proceeds more rapidly at certain points. Thus the channel rocks at the foot of the river-reach in question are composed of fine sandstones (Potsdam) compacted with bluish clay, and are being rapidly eroded; and at a not excessively remote date the channel will be so lowered that the upper and lower lakes will form one navigable level, while the channel to the west, having a much harder bed-rock, will be changed to impassable rapids by the subsidence of the lake below them. Reference was made to various older channels which evidenced former higher levels which the existence of terraces and undoubted water-lines fully confirmed. In the discussion that ensued, several members who had visited the locality and other portions of the Upper Ottawa gave evidence as to the existence of numerous traces of old water-currents at points now much above the present levels.

Mr. H. M. Ami presented a list of the Cambro-silurian fossils of the neighborhood, containing 228 species, and prefaced by a few notes as to its compilation. The report of the geological section on the summer's work was also read, and the president announced that classes in botany and zoölogy would be held weekly.

Franklin institute, Philadelphia.

Jan. 16. — The annual report of Board of managers exhibited the addition of a hundred and thirty-nine new members during 1883, and of over three thousand volumes to the library. Preparations for the Electrical exhibition, to be held during the autumn of 1884, are in an advanced state. A national conference of electricians is in contemplation. The subject of a "Proposed ordinance for the examination of steam-engineers" was warmly debated, *pro* and *con*, but no decisive action was taken. Mr. S. Lloyd Wiegand read a paper defending the use of cast iron in the construction of steam-boilers, it having been alleged by Nystrom and others that steam-boilers with flat cast-iron heads were dangerous. The secretary's report embraced a summary of engineering and industrial progress for the past year.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

The U. S. naval observatory.

Vice-Admiral Stephen C. Rowan was appointed July 1, 1882, to succeed Rear-Admiral John Rodgers as superintendent of the observatory. On May 1, 1883, Vice-Admiral Rowan was relieved by Rear-Admiral R. W. Shufeldt. The report of Admiral Shufeldt to Commodore J. G. Walker, chief of bureau of navigation, under date of Oct. 22, 1883, covers the work of the observatory for the past year.

The *personnel* of the observatory is as follows: —

Rear-Admiral R. W. Shufeldt, superintendent; Commander W. T. Sampson, assistant to superintendent; lieutenants, Pendleton, Moore, Bowman, Gar-

vin, Wilson, Harris, Sewell; ensigns, Brown,[1] Allen, Taylor, Hoogewerff; professors, Hall, Harkness, Eastman, Frisby; assistant astronomers, Skinner, Winlock, Paul; clerk, Thomas Harrison; computer, W. M. Brown, jun.; computers (transit of Venus), Woodward, Flint, Wiessner, A. Hall, jun.; instrument-maker, W. F. Gardner; also three watchmen and nine laborers.

The report, which is not yet published, contains a brief account of the work accomplished with the principal instruments of the observatory, — the 26-inch and 9.6-inch equatorials, the transit circle, prime vertical and meridian transit, — and the progress in the chronometer department, the department of nautical instruments, the library, and also in the reductions of Gilliss's Zones of 1850, 1851, 1852.

The 26-inch equatorial. — This instrument has been in charge of Prof. A. Hall, with Prof. E. Frisby as assistant. Mr. George Anderson is employed as an assistant in the dome. The canvas covering for the opening of the dome is still used, and a change in the raising and lowering of this covering has been made in order to avoid the friction of the wire ropes. Thus far the new arrangement has worked well. This equatorial has been employed, as in preceding years, for the observation of double stars, satellites, and comets. The satellites of Saturn, Uranus, and Neptune have been observed; and we have now collected a large number of observations of these satellites. The ring of Saturn has been observed, but no remarkable changes have been noticed. In fact, many of the strange phenomena frequently described in connection with this unique ring, the observers here fail to see on the best nights. During the greatest opening of the ring, which is near at hand, it is intended to make a set of micrometric measures of the dimensions of the ring. Some observations for stellar parallax have been undertaken; but, as the observer resides at some distance from the observatory, such work is very laborious, and it seems better to defer it until more convenient arrangements are made. At the present time the pressing need on this instrument is, that the observations of satellites already made should be discussed for the purpose of correcting the orbits of these satellites, and of determining the masses of the planets. This discussion has been begun, and the numerical calculations are being made by Ensigns W. H. Allen and J. A. Hoogewerff.

The transit circle. — This instrument, in charge of Prof. J. R. Eastman, was employed in the same class of work as in 1881–82. The observers were Professor Eastman, and Assistant astronomers A. N. Skinner, Miles Rock,[2] and W. C. Winlock. Professor Eastman was absent, in charge of a transit of Venus party at Cedar Keyes, Florida, from Nov. 1, 1882, to Jan. 1, 1883. Assistant astronomer Miles Rock, who was detached in September, 1882, for duty with the transit of Venus party at Santiago, Chile, was away until Feb. 10, 1883. The whole number of observations made with the transit circle from Oct. 18, 1882, to Oct. 18, 1883, is 3,880.

[1] Appointed professor of mathematics, U.S.N., Oct. 13, 1883.
[2] Succeeded, Nov. 1, 1883, by Prof. H. M. Paul.

The meteorological observations have been continued, as in former years, by the watchmen.

The 9.6-inch equatorial. — This instrument has been in charge of Commander W. T. Sampson, assisted part of the time by Lieut. W. E. Sewell, and part of the time by Lieut. John Garvin. It has been used, as in former years, in observations of the phenomena of Jupiter's satellites, occultations by the moon, places of comets, and for obtaining corrections to the ephemeris places of minor planets.

Prime vertical instrument. — This instrument is in charge of Lieut. C. G. Bowman, assisted by Ensign H. Taylor. Observations with it were recommenced Nov. 14, 1882. Continuous observations have been restricted to about forty stars, in no case exceeding 2° zenith distance when on the meridian; and these, with one exception, have been closely confined to the time of the two maxima of aberration. The one exception referred to was in the case of α Lyrae, which has been regularly observed throughout the twenty-four hours, having in view the possibility of a determination of its absolute parallax. Up to this time about five hundred and eighty observations have been secured. In the reductions, Struve's formulae have been used; and the labor has been greatly lessened by the use of his auxiliary tables for the prime vertical transit.

Meridian transit instrument. — This instrument has been in charge of Lieut. U. R. Harris, and Lieut. E. C. Pendleton has assisted. Since July 10, Lieuts. Pendleton and Harris have alternated in determining the correction of the standard mean-time clock. The meridian transit instrument has been used for the observations of stars of the *American ephemeris* for clock and azimuth corrections, and the determinations of the right ascensions of the sun, moon, and major planets. The total number of observations of the character mentioned is fourteen hundred and eight. Observations have been taken as often as practicable, to obtain each day the correction of the standard mean-time clock for setting to correct time the transmitting clock, which is used in sending out the time-signals from the chronometer-room, and in rating the chronometers.

National museum.

Publications. — Volume 5 of the 'Proceedings of the National museum' has just been issued from the Government printing-office. It contains 703 pages, and includes 87 articles by 34 authors, grouped topically as follows: mammals, 4; birds, 21; reptiles, 2; fishes, 48; mollusks, 3; crustaceans, 1; insects, etc., 2; plants, fossil and recent, 4; minerals and rocks, 2; art and industry, 1.

Catlin Indian paintings. — The Catlin collection of Indian paintings recently given to the museum by Mrs. Joseph Harrison of Philadelphia, is now being prepared for exhibition. This collection consists of over six hundred paintings, chiefly portraits and delineations of ceremonies, games, and hunting-scenes, made by the artist during eight years' residence in the western territories, Mexico, and British North America, previous to 1840. It contains authenticated

portraits of three hundred and fifty men and women, and over three thousand figures of Indians of the tribes known as Sacs, Foxes, Konzas, Osages, Comanches, Pawnees, Kiowas, Sioux, Omahas, Missouries, Mandans, Flatheads, Blackfeet, Crows, Gros Ventres, Crees, Assineboins, Chippewas, Iroquois, Ottawas, Winnebagoes, and twenty-seven other tribes. Its value as a record of ethnological characters is inestimable.

There were two collections, — one consisting of the original paintings done in the field, exhibited by Mr. Catlin for many years in Europe; the other, copies made at a later date, which was exhibited in the old Smithsonian building many years ago, and now the property of Mr. Catlin's heirs. The collection given to the museum is the original one, and is regarded by artists and ethnologists as by far the most valuable. The pictures, which have been for fifteen years stored away in a warehouse in Philadelphia, are in a remarkably good state of preservation.

There are also on exhibition five paintings by Stanley, — all that remains of the Stanley collection of Indian paintings destroyed by the fire in the Smithsonian building in 1865.

Naval officers in the museum. — In continuance of the policy adopted two years ago, the secretary of the navy has detailed six more ensigns to duty in the museum. These are graduates of the Naval academy in the classes of 1877–79, who have just finished their first three years' cruise, and will now give two years to scientific work under the direction of the officers of the museum. Mr. C. S. McClain has been assigned to the department of marine invertebrates; Mr. C. H. Harlow, to that of arts and industries; Mr. H. M. Witzul, to metallurgy; Mr. H. S. Knapp and Mr. O. G. Dodge, to mineralogy.

Department of mineralogy. — Prof. F. W. Clarke, chemist of the Geological survey, has been appointed honorary curator of minerals, and is preparing a series of minerals for exhibition. Mr. W. S. Yeates, aid in the museum, who has been in temporary charge of the minerals since the death of Dr. Hawes, the former curator, is acting as assistant in this department.

Mr. Joseph Willcox of Philadelphia has deposited his collection of American minerals in the museum, and one thousand of the choicest specimens have been placed on exhibition.

Foods and textiles. — Mr. Romyn Hitchcock is acting as assistant curator, having in charge the collections of foods and textiles. The collection is very rich in the textile products of the Indians, and has considerable quantities of food-materials acquired from foreign governments at the close of the Philadelphia exhibition.

Explorations in Corea. — Mr. Pierre L. Jouy, of the museum staff, is attached to the American embassy in Corea, and is making zoölogical explorations. Ensign J. C. Bernadou, U.S.N., has sailed for Corea, to spend two years in ethnological and mineralogical explorations. Mr. Bernadou was one of the officers detailed to duty at the museum last year.

Voyage of the Albatross. — The steamer Albatross sailed from Norfolk, Jan. 8, for a four-months' cruise in the Caribbean Sea, in the service of the hydrographic office of the navy. She is under command of Lieut. Z. L. Tanner, and carries a special staff of zoölogical workers, including Mr. J. E. Benedict, naturalist in charge; Mr. Willard Nye, jun.; and Ensigns Miner, Garrett, and Ackerman, U.S.N., of the museum staff.

Mammal department. — Mr. Frederick W. True, curator of mammals, is in England, studying methods of investigation and museum administration with Professor Flower, at the Royal college of surgeons in London.

Foraminifera. — Prof. L. A. Lee of Bowdoin college was in Washington, Jan. 3 to Jan. 8, studying the museum collections of foraminifera with reference to his investigations upon the materials obtained by the Fish commission.

Director's office. — During the reconstruction of the east end of the Smithsonian building, Professor Baird is occupying an office in the north-west pavilion of the museum.

NOTES AND NEWS.

All the parties sent out by the various governments at the suggestion of the International polar commission have returned home safely, and with valuable meteorological and magnetic records, with the exception of three. The Russian station at the mouth of the Lena will continue its work for another year, on account of delay from storms in reaching its destination. The Finnish, at Sodankyla, although it has finished one good year's work, will continue for another, as the government of Finland has supplied the necessary funds. The misfortunes of the Greely party are too well known.

— The first number of the *Auk*, published under the auspices of the newly organized American ornithologists' union, closely resembles the Bulletin of the Nuttall club, of which it is the continuation, and bids fair to be a credit to American ornithologists. An excellent colored plate forms a frontispiece to the number, and the articles are varied and interesting. One would perhaps justly complain of the space given to disputes over words, and lament the entire absence of papers upon either the anatomy or the general structure of birds, but these are perhaps to come in future numbers; and there is a pleasant flavor of careful out-door observation running through some of the papers, such as those of Messrs. Brewster, Barrows, and Bicknell. The effect of the formation of the union four months ago, is already seen in the plan offered by the committee charged with the subject for co-operative work in the study of bird-migration on this continent. We think a brief account of the formation and purpose of the union would have been a fitting introduction to the number.

— Professor F. M. Snow of the University of Kansas, from observations taken at Lawrence, reports that only three Decembers in the past sixteen years have been milder than that just passed, — 1875, 1877,

and 1881. There were very few days during the month in which building operations were not actively pushed. The sky was clearer, the wind was higher, and the rainfall was more than fifty per cent smaller, than the December average. The remarkable prolonged crimson and orange sunset glow, which was observed in the last week of November, continued with a somewhat intermittent brilliancy during the month of December.

— We take the following personal notes from *Nature*: —

Prof. W. H. Macintosh has been elected to the professorship of comparative anatomy in Trinity college, Dublin, *vice* Professor Macalister, F.R.S., who resigned on his appointment to the anatomy chair at Cambridge. —— By the death of the well-known mathematician, the Rev. W. Roberts, M.A., the Rev. Richard Townsend, M.A., F.R.S., becomes a senior fellow of Trinity college, Dublin, thereby vacating the professorship of natural philosophy held by him since 1870. —— The vacancy in the professorship of geology and mineralogy, in the University of Dublin, has been filled by the election of Professor Sollas of University college, Bristol. This appointment will give great satisfaction, and will afford Mr. Sollas large opportunities for paleontological research; the large collections of fossil plants and vertebrates in the museum in Dublin remaining to this day almost unknown. —— M. Houzeau, who was only recently appointed director of the Brussels observatory, has resigned his post; and it is reported that M. de Konkolly of Gzalla observatory, Hungary, will succeed him.

— The Swedish government intends to establish a botanico-physiological station in the north of Sweden for the study of the flora and the diseases of the crops in that part of the country.

— The Finnish government has ordered a steamer to be specially built in Sweden for the scientific researches about to be prosecuted in the Baltic.

— Lord Rayleigh has reprinted for private circulation, in pamphlet form, several of his most valuable optical papers, including those on the manufacture, reproduction by photography, and theory, of diffraction-gratings, and those on color-mixtures. He has also reprinted some of his papers on electricity and on absolute pitch, from *Nature* and from the reports of the British association, in a convenient pamphlet form.

— At its annual meeting, Jan. 11, the Cambridge entomological club elected the following officers: president, Samuel H. Scudder; secretary, George Dimmock; treasurer, B. P. Mann; librarian, C. C. Eaton; executive committee, Roland Hayward and T. W. Harris.

— Prof. H. Carvill Lewis, of the Academy of natural sciences of Philadelphia, has been appointed lecturer on geology and paleontology at Haverford college, Pennsylvania.

— A dissertation on the 'Proper names of Panjabis,' with special reference to the proper names of villagers in the eastern Panjab, by Capt. R. C. Temple, Bengal staff corps, contains a study of the proper names of the peoples of the Panjab. The book contains, also, long lists of names, showing by what classes of the population the various kinds of them are used, and is provided with an index to over four thousand proper names. The book is published at the Education society's press, Bombay, and by Messrs. Thacker Spink & Co. in Calcutta, and Messrs. Trübner & Co., Ludgate Hill, London.

— Sampson, Low, & Co. announce 'Heath's fern portfolio,' — a series of life-size reproductions of ferns, being in form, color, and venation, accurate representations. The work is to be published in monthly parts.

— The *Publishers' weekly* announces that Rev. A. B. Hervey of Taunton, Mass., has translated Dr. Behren's book on methods of conducting microscopical investigations in the botanical laboratory. He has enhanced the value of the translation by adding the methods of work used in this country.

— Cupples, Upham, & Co., Boston, have ready 'The amphitheatres of ancient Rome,' by Clara L. Wells.

— Schuver, during recent explorations in the Galla country, purchased from them a young negro of a race called Gambil, from whom he obtained interesting details in regard to his people. It appears, from his account in the *Revue géographique*, that the Gambils live on the Komonshi River, an affluent from the right bank of the Sobat, — a name which signifies Cow River, because in the dry season their numerous herds find forage only along its banks. Ostriches and elephants abound. They have a tree which bears a fruit two feet long, weighing ten or twelve pounds, which is softened in water, dried, and eaten. The principal village is Komonshok; but some thirty others were named by this negro, among them Kepil, which is a market where iron, copper, and beads are bought by the Gambils from the Gallas. They eat fowls and eggs, which the Gallas abominate, and raise pigs. They break out the two lower incisors, and wear two little horns of the gazelle or goat on the forehead. Some years since, they were attacked by the Denkas, who almost destroyed the tribe; many of whom, for safety, offered themselves as voluntary slaves to the Lega Gallas.

— At the November meeting of the London society of biblical archaeology, Mr. Pinches read a paper on Babylonian art, as illustrated by Mr. Rassam's latest discoveries. Among the discoveries on the site of the ancient Sippar, Mr. Pinches considers the most important to be a "small egg-shaped object of beautifully veined marble, pierced lengthwise with a rather large hole, and engraved with an inscription of seven lines (two double) containing the name of Sargon of Agade (3800 B.C.)."

Another small object, made of a dark-green stone in a bronze socket engraved or cast in the shape of a

ram's head, bears an inscription stating that it was presented to Samas, the sun-god, by a king of Hana. From the character of the writing, Mr. Pinches places the date of the relic at about 850 B.C., and draws from the fact that it was presented by a foreign king the conclusion that the shrine of the sun-god at Sippar must have attained to great renown.

Another most interesting object of about the date 685 B.C. is a lion's head carved in white limestone, perhaps originally forming a part of some piece of furniture. "The mouth, which was opened threateningly, showed the well-formed teeth. Above the upper lip were, on each side, five curved, sunken grooves, which were formerly inlaid with some material, probably to enable the long feelers or whiskers to be inserted. Wavy grooves for inlaying were also to be seen above the nose. The eyes were inlaid, and the holes for the insertion of the long hairs forming the eyebrows still remained. In the middle of the forehead there had originally been inserted the little winged figure emblematic of the god Assur." The accompanying inscription contains the names of the Assyrian kings Sennacherib and Esarhaddon.

Among other objects mentioned were statues of the sun-god and his attendant deities, all clothed in long robes. The reader pointed out that the specimens of art found by M. Sarzec at Tel-lo are finer than those found by Rassam at Sippar; the former coming from the more polished Akkadian, the latter from the more powerful but less refined Semite.

— The domestication of the ostrich in South Africa is of only some fifteen years standing, all previous product of plumes being due to hunting. At first there was much opposition to the proposal; and it was fancied that the plumes of domesticated birds would prove of inferior quality, which has not turned out to be the case. In 1865 there were only eighty, but in 1883 there are more than a hundred thousand tame ostriches. They have even been introduced into California. In 1880 forty millions of capital was engaged in the business, and a hundred and sixty-three thousand pounds of feathers were exported from the Cape, worth nearly $4,200,000. The birds are kept in enclosures, which, in a natural state, must be twenty or thirty acres in extent per pair. When the area is diminished, they must be supplied with food. They begin to breed at the age of four years, but produce plumes after their first year. The plumes are cut or pulled out. In the latter case injuries sometimes result, both to birds and manipulators; so that the former process is preferred, although after six weeks it is necessary to remove the withered remains of the shaft. The feathers are classed according to their character; as, wing feathers (white), female feathers (white), tail feathers, fancy feathers (black and white), black feathers (long, medium, and short), and lastly gray feathers. Formerly the Cape plumes took only the sixth rank after those from Aleppo, Barbary, Senegal, Egypt, and Mogador, valued in the above-mentioned order. Now, however, the Cape plumes are ranked as high as any. The largest exportation is from Port Elizabeth. England is the great market, followed by France. New York is lately taking an important place in the trade. The value of the feathers has diminished one-third under the increase of production, but the cost of the birds has also diminished. A pair of breeders has been sold within two years for twelve hundred dollars; but at present a pair can be had for two hundred to two hundred and fifty dollars. Under good conditions, a bird produces fifty dollars' worth of plumes per annum, to which must be added the value of the eggs and chicks.

— The Catholic missionaries who have recently established themselves among the Massanzé on the west of Lake Tanganyika are meeting with a good deal of success. The men of the district, great travellers, speak mostly a jargon of several languages. Their own tongue is only heard in purity from the women, by whose aid a grammar and vocabulary have been prepared. An excitement was recently caused by one of the whites cobbling a shoe over an iron last. The natives took this for an actual white man's foot which had been cut off; and one of the missionaries was obliged to take off his foot-gear to satisfy them that white men had toes. The Uambembé, reputed cannibals of the adjacent mountains, who have never suffered any whites to enter their territory before, have welcomed the missionaries, and offered them sites for residence in the villages of the three principal chiefs. This mission-station will be re-enforced very shortly.

— The Stirling Castle, constructed at Glasgow especially for the China trade, during the past season has brought from Woosung to London a cargo of tea in thirty-one days. This is four days shorter than the best previous record. The vessel is supplied with engines of eighty-five hundred horse power, and maintained a perfectly regular speed of eighteen knots throughout the journey.

— In view of the constantly increasing number of meteorological stations in Russia, Rikacheff, vice-director of the Central physical observatory, has undertaken a careful verification of the instruments, methods, and conditions at the different stations.

— A. Roberjot, of the French navy, gives, in the *Bulletin* of the French society of geography, the results of a voyage in 1879 among the New Hebrides, and accompanies them by a small chart and several woodcuts in the text. The naval vessel Second sailed from Noumea, New Caledonia, and touched at various islands, beginning at the south-east with Annatom, and ending with Espiritu Santo to the north-west. Numerous interesting facts in regard to the present condition of the natives, some short lists of words and details in regard to the character of the several islands, are given, and form a useful contribution to our knowledge of a people who are rapidly changing under the influences of missionaries, civilization, and the so-called 'labor-trade,' which appears to be a kind of slavery into which the chiefs sell their unresisting people.

SCIENCE.

FRIDAY, FEBRUARY 1, 1884.

COMMENT AND CRITICISM.

As it has now been determined that the Greely relief expedition of 1884 shall be placed in the hands of naval officers, and that suitable vessels shall be purchased for the purpose, it is perhaps advisable to remind those interested of certain essential features of the task before us. It is desirable, that, whatever plans be adopted, it be distinctly remembered that the object of the expedition is to relieve Greely and his men; that it is essential to success that training and brains should lead the expedition, and that a mere naval training is not a sufficient qualification without experience in ice-navigation; that the praiseworthy ambition common to the best naval officers does not fit them for such technical work, any more than it would to write an epic poem; and, lastly, that qualified men may be had, and should be engaged, even if not nominally in command, and their advice should have controlling weight.

We pointed out some time since, that the responsibility for failure would be laid where it belongs, by the public, regardless of official pride or red tape. That brave men should perish because points of precedence cannot otherwise be comfortably settled, is unendurable. It is probably better that only one branch of the service should be concerned in the expedition. That this was not the case in 1883 is generally (whether rightly or not) supposed to have some connection with the *fiasco* which is now a matter of history. Apart from that, there is little doubt that Capt. Pike felt his judgment of the propriety of pushing into the ice overruled by the officer in charge, whether that officer was conscious of his influence or not. In the present expedition not the smallest loophole should be left for any such proceeding, or it is predestined to failure.

It is most unfortunate that at the present time we have probably not a single ranking officer in the navy of experience in the sort of navigation the expedition must necessarily encounter. However, since it is the case, it should be recognized in the organization of the expedition; and, if any doubt exist as to the willingness of the naval authorities to provide for the deficiency by availing themselves of technical knowledge outside of the service, a mandatory clause to this effect might well be inserted in the act of Congress providing for the expedition. It may be thought that we reckon too lightly the effect of the grave responsibility which will fall on the officers who may be selected; but the record of the two previous expeditions for the same purpose is a sufficient warranty for reasonable scepticism.

In order to secure to the fullest extent the unusual advantage arising from the coincidence in the time of holding the proposed International electrical exhibition in Philadelphia, and of the meeting of the American association for the advancement of science in the same city, in connection with the anticipated visit of the members of the British association to that city, the Franklin institute has appointed a special committee to confer with scientific men as to the best method to be adopted for securing, during the month of September, the assembling at Philadelphia of a conference of electricians. To defray the expenses of such a conference, a bill has been prepared, asking for a small appropriation from Congress. Scientific men interested in this measure are earnestly requested to give it all the aid in their power. Communications on the subject are respectfully requested by the committee, consisting of M. B. Snyder, Edwin J. Houston, William H. Wahl, W. P. Tatham.

One cannot fail, while reading books of travel, to note the poverty of geographic terminology.

Even those explorers who attempt to describe closely what they see are hampered by the lack of terms of precise meaning with which to name the elements of a landscape; for, apart from the rarity of teaching in this important branch of physical geography, there is too little recognition of the connection that necessarily and often clearly exists between internal structure and external form, — too great neglect of the evolution of topography, during which the features of youth, maturity, and old age, succeed one another. There should be a terminology as well defined and extensive as that which botanists have invented for the description of leaves; for it is about as indefinite to call a country hilly as to call a plant leafy. There should be a collection of typical forms in models or figures marked with descriptive terms, approved by some authoritative body, to serve as a standard by which travellers might be trained. The question is well worthy the attention of geographic societies and congresses.

It is much to be regretted that it has been found necessary to suspend the operations of the Northern transcontinental survey. It was organized about two years ago, under the direction of Mr. Raphael Pumpelly, to obtain a comprehensive and authoritative knowledge of the resources of the vast region in the northwestern part of our country tributary to the Northern Pacific railroad and the associated companies, at whose cost it was undertaken. Up to that time this extensive territory, embracing, perhaps, one-fifth of the United States, had been very imperfectly explored geographically, and was still less known as regards those resources which will contribute to the business of the railroads that traverse it. A large amount of accurate information has now been gathered, and in small part published. Mr. A. D. Wilson, of broad experience in western exploration, was put in charge of the topographical work, with Messrs. Goode and Nell as chief aids; and we have just received a set of six maps, the fruit of their first season's surveys, a notice of which will be found in the 'Notes and news.'

From a circular just issued by Professor Dohrn, we learn that the cost of publishing the *Zoologischer jahresbericht* for 1879 and 1880 amounted to nearly $7,000, while the income from sales of the publication amounted to only $2,317. The zoölogical station at Naples has thus been obliged to meet a large deficit, amounting to at least two-thirds of the cost of publication. It is plainly not within the means of the station to continue indefinitely this work without assistance. The governments of Italy, Germany, and Russia, as well as one or two zoölogical societies of Holland, have made subventions which cover about one-third of the deficit. The three volumes of this work already completed speak for themselves. Every naturalist will learn with regret that a work of such general usefulness is in danger of being discontinued from the cause above named. We certainly hope that Professor Dohrn's appeal for assistance will meet with a liberal response, both in the way of subscriptions for the *Jahresbericht* and in subventions.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Earthquake waves at San Francisco.

Assistant George Davidson telegraphs the superintendent of the U. S. coast and geodetic survey from San Francisco, that at 7 h. 24 m., last evening, earthquake waves were indicated by the delicate levels of the astronomical instruments of the observatory. The amplitude of each vibration was three seconds of arc, in three seconds of time, and they continued for twenty minutes.

C. O. Boutelle,
Assist. in charge of office, etc.

Coast and geodetic survey office,
Jan. 26, 1884.

Influence of winds on tree-growth.

I notice at p. 471 of the issue of *Science* for Oct. 5 some remarks by Mr. W. S. Kennedy on the influence of winds on tree-growth. It may be of interest to learn that many of the trees on the seashore at Government House, Malabar Point, Bombay, are bent landward from the effect of the prevailing sea-breeze.

H. Rivett-Carnac.

Allahabad, N. W. P., India,
Dec. 8, 1883.

Some curious natural snowballs.

On p. 237, vol. i., of *Science*, under notes and news, is a reference to some curious snowballs noticed in *Scientific American* for March 17. Such an exhibition I lately saw; and it may interest readers of *Science* to know the conditions favoring such a phenomenon.

On Jan. 8 and 9 some thirty inches of snow fell in this region, followed by warmer weather and light rain on the night of the 10th, settling the snow into a

compact mass. On the 11th and 12th came freezing weather, and the fall of a small amount of very light snow. On the 13th the thermometer, toward noon, rose above freezing-point, with a stiff breeze from the south. This wind so acted on the surface-particles of the upper layer of uncompacted snow as to set some of them in motion. Each particle thus set in motion, owing to the soft condition of the surface-snow, formed a nucleus, which, as it proceeded, forced along by the wind, gathered the contiguous portion of the soft layer, and assumed the form of a cylinder, with a conical cavity at each end, and having a length about twice as great as its diameter. The size depended upon the inclination and smoothness of the surface traversed. The largest cylinders I saw were about three feet long, at which limit they acquired sufficient weight to indent the frozen surface of the under or main body of the snow. This, of course, stopped the further rolling of the mass. The only locality where they acquired the above large size was where the surface had a slight inclination to the north; and the snow was deep enough to cover all weeds, leaving a perfectly uniform and smooth surface for their formation. In many cases the balls were rolled up an inclination of as much as one foot in ten, when exposed to the unbroken force of the wind; but those thus formed acquired weight sufficient to resist the pressure of the wind, when about six inches in diameter. When the surface inclined toward or directly away from the wind, the balls traversed a straight path; but, when the surface declined to the north-east or north-west, the path was a curve; at its initial, approximately straight; but, as the ball acquired weight, its direction was a compromise between that required by gravity and that by the direction of the wind, until, in some cases, the ball obeyed gravity alone. The most curious part of the display was the abundance of the balls. While travelling three miles, I saw what I estimated at over a hundred acres dotted more or less thickly with the cylinders. In some cases there were twenty-five balls to the square rod; in others, only two or three; averaging, perhaps, eight or ten. I saw multitudes in the process of formation, which was as sudden as a flash; but they almost immediately assumed a slow rate of motion, about that of a mole taking his leisurely walk. In a few cases the cylinders would stop, and afterward be forced into motion again. The largest examples required for their formation the traversing of from two to three rods. SAM HUSTON.

Richmond, O., Jan. 16, 1884.

The wind performed a very pretty feat in some portions of northern Ohio on the morning of Jan. 13. Loose bits of snow were caught up as a nucleus, and rolled along upon the surface until balls of considerable size and peculiar shape were formed. The whole surface was strewn with the balls; but they were most abundant upon lawns and fields where the wind was not obstructed, every square yard, in some places, bearing a ball of greater or less size. The largest observed here were upon the college ball-grounds, where they reached ten inches in height, and a horizontal length of eighteen inches. Even these were swaying as the gusts passed over them; and their tapering track could be plainly traced back towards the south-west, twenty-five or thirty feet, to the apex where they started. Their shape was cylindrical, deeply hollowed at both ends, so that they looked like 'muffs,' and the spiral formed by the successive layers was finely regular and distinct.

The meteorological conditions which made the phenomenon possible were as follows. Two days before the occurrence a slight crust was formed upon the snow. On the following day an inch of light flaky snow fell upon this crust. Then followed the warm south-west wind on the morning of the 13th, which brought the upper layer of snow into the adhesive state, and rolled the balls before the crust was weakened; the crust sustaining the balls, and keeping them up to the wind, and at the same time furnishing a smooth floor upon which they could be propelled. The nuclei of the balls were obtained from chance foot-tracks, walk-borders, lumps blown from trees, etc., though often it was difficult to account for them. The balls were most abundant and perfect at about nine o'clock A.M. Before noon the crust had been attacked, and all sunk to rounded, insignificant clumps.

Oberlin, O. ALBERT A. WRIGHT.

[Similar snow-rolls were seen at Sharpsville, Mercer county, Penn., on the same day, by J. M. Goodwin.]

Halos round the moon.

On the evening of Jan. 12, at 9.20 (90th meridian time), my attention was called to a peculiar appearance about the moon. The sky was quite clear at the time, and there appeared around the moon several colored circular bands. The first was of a bright silver-gray shade, and about two diameters of the moon in width. The next was yellow, the next faint orange, and the next violet. The three bands were each about one-half a diameter in width. The outermost band was of a green shade, and about two diameters in width. At ten o'clock the innermost light band remained, but all the others had been replaced by a blue band lighter than the surrounding sky.

H. A. HUSTON.

Lafayette, Ind., Jan. 14, 1884.

Explorations in Guatemala.

Looking over the back numbers of your esteemed journal, I came across a slight error. In the article 'Lorillard City' it is said (ii. 412), "M. Charnay found the ruins of an ancient city, which he named after his generous patron. In his exploration here, he was assisted by a young Englishman, Mr. Alfred Maudslay, with whom he shares the honor of discovery," etc.

Neither Mr. Maudslay, who arrived at these ruins before Mr. Charnay, nor the latter, can claim this honor. In fact, Mr. Maudslay distinctly states (p. 196 of the *Proc. roy. geogr. soc.*, April, 1883) that they have been discovered by Mr. Edwin Rockstroh, tutor on the Lyceo nacional at Guatemala City. This gentleman made, during the first half of 1881, a geographical and archeological exploration in the northern and western parts of the republic, visiting Tikal, and navigating the Rio de la Pasion, Rio de las Salinas, Rio de los Gacandones, and the Usumasinta as far down as the ruins mentioned. He sent a short account of this voyage to Petermann's *Mittheilungen* (1881, p. 396).

In that account Mr. Rockstroh mentioned particularly the building described by Mr. Maudslay on p. 198 of the geographical society's proceedings; and (1882, on p. 435) he clearly states that Charnay's 'Lorillard City' is the same as that discovered by him in 1881. Mr. Rockstroh mentioned in his first letter to the *Mittheilungen* (July 19, 1881), that the Gacandones call these ruins 'Menche,' and promised in his last notice (1882, p. 435) an explanation of this name. I am not aware that he has furnished one.

I find in the 'Historia de la provincia de San Vicente de Chiapa y Guatemala,' by Antonio de

Remesal (Madrid, 1619), libro xi., cap. xviii.–xx., pp. 720–733, a province 'el Manché' mentioned as one of the provinces of Vera Paz, the Indians of which were converted in the years 1603 and 1604. Mr. Maudslay's map contains the Rio del Manché, an eastern tributary of the Rio Sta. Izabel, which latter, in its lower course, is called Rio de la Pasion. The province of Manché must evidently have been situated on the river of the same name, to the north of the village Cahabon, which was the starting-point of the Padres for their trip of conversion, as Remesal states.

Whether the name of this province, 'Manché,' has any connection with the word 'Menche,' as Mr. Rockstroh says the ruins on the Usumacinta (separated by a mountain chain from the central part of the Peten district) have, remains to be seen.

In regard to the notice in the same number and on the same page of *Science*, 'Explorations in Guatemala,' I beg to add, that the ruins of Tikal had been discovered in February, 1848, by Mr. Modesto Mendez, corregidor of the district of Peten, and by the gobernador Ambrosio Tut. Mr. Hesse, minister of Prussia in Central America, published the report of Mr. Mendez, dated March 8, 1848, in vol. i. of the 'Zeitschrift für allgemeine erdkunde' (Berlin, 1853, pp. 162–168), and added some general remarks, and two plates which he had carefully copied from Mr. Mendez's drawings. These plates contain the illustrations of four sculptures (in wood) and five monoliths discovered by Mr. Mendez in Tikal, and those of four monoliths discovered by him in 1852 in Dolores, — another town with ruins, to the south of Tikal, in the same district of Peten. The chairman of the Royal geographical society is therefore mistaken in stating (p. 203 of the Proceedings) that the ruins of Tikal were described for the first time by Mr. Maudslay.

The report of Modesto Mendez is mentioned by Mr. A. F. Bandelier in his Bibliography of Yucatan and Central America, in 'Proceedings of the American antiquarian society,' 1880, p. 92.

HERMAN BIGALKE.

787 Eighth Avenue, New York.

Barn-owls in Missouri.

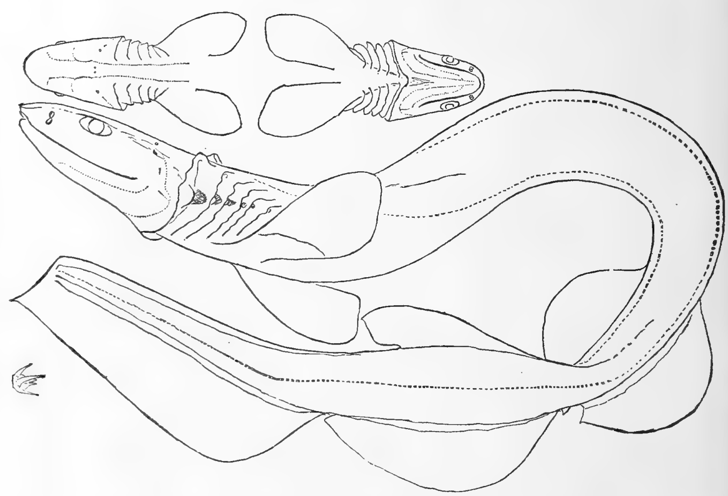
In *Science* for Jan. 11 the occurrence of the barn-owl in southern Ohio in unusual numbers the present winter is recorded. The same fact has been noticed here. Four have been caught in the city in as many different buildings, and a number took up their habitation in an unused chimney in one of the principal residences in the city. Another was killed a few miles out. They are so unusual here that no one knew what kind of owl they were when the first was captured.

F. A. SAMPSON.

Sedalia natural history society,
Sedalia, Mo.

A PECULIAR SELACHIAN.

THE outlines given here are taken from a shark recently discovered in Japanese waters. It is a form of more than ordinary interest on account of the respects in which it differs from the majority of its kindred. 'Is it a sea-serpent?' is asked by all who see it. Those who believe in the existence of the ocean monster may certainly derive some encouragement from the discovery. About the throat the appearance is decidedly fish-like. The body is long and slender, five feet in total length, and less than four inches in greatest diameter; it becomes compressed and thin toward the tail. The head is broad, slightly convex on the crown, and has a look about it that reminds one of some of the venomous snakes. The mouth is anterior and very wide. As in other sharks, the teeth are arranged in rows across



CHLAMYDOSELACHUS ANGUINEUS.

the jaws; they are all alike. Each tooth has three slender, curved, inward-directed cusps, and a broad base, which extends back in a pair of points under the next tooth, thereby securing firmness, and preventing reversion. In the twenty-eight rows of the upper jaws, and twenty-seven of the lower, there are three times as many rows of the fangs or cusps. Of the six gill-openings, the anterior are very wide. Unlike other Selachians, in this the frill, or flap, covering the first opening is free across the isthmus, as in fishes, and hangs down about an inch. On the body the slime-canals — shown by the dotted lines in the sketch — form continuous grooves, as if the skin had been cut with a sharp knife; they extend to the extreme end of the tail. The spiracles are so small as to be useless; but, being present, they point toward an ancestor, a bottom-feeder, in

which they were more developed. In the nearly vertical nostril there is a peculiar arrangement. A fold reaching out from each side divides the opening into two, connected within, the upper of which looks forward, and, when moving ahead, catches the water, and turns it into the nasal cavity to pass over the membranes and escape by the lower aperture, which looks backward. Nictitating membranes are absent. The eyes are placed to look sidewise and downward. Above the anal fin, there is a small dorsal. The pectorals are of moderate size. Ventrals, anal, and caudal are large. From these fins, if it were not for lack of firmness toward the edges, one would conclude the animal was capable of great speed. However, taking into consideration the size of the branchial apertures — which allow the water entering the mouth free escape, whatever the rate of motion — and the position of the large fins, it seems as if the creature had the habit of bending the body and striking forward to to seize prey, as do the snakes. The broad fins, so far back on the body, secure a fulcrum from which to strike. At their margins the fins are very thin, and their extremities are produced in a sort of filament. The structure of the jaws and gill arches is such as to admit of swallowing a large object. At the same time the excessive sharpness of the teeth, and the smallness of the intestine, indicate that the prey is comparatively soft. The vertebrae and other cartilages are flexible, as those of the basking sharks Selache and Somniosus. A certain embryonic appearance in the specimen instigated a search among the fossils for allied species. Most resemblance was found in the teeth of Cladodus of the Devonian; but the cusps were erect instead of reclining, and the enamel was grooved or plicate instead of smooth. One is impressed by a study of this specimen with the idea, that, away back in times when Selachia and fishes were more alike, he would have a better chance to trace the affinities. The Bulletin of the Essex institute, vol. xvi., contains description and figures under the name Chlamydoselachus anguineus. I am inclined to consider this the type of a new order, to which the name Selachophichthyoidi might be given, and which stands nearer the true fishes than do the sharks proper. The shark was secured in Japan by Professor Ward, from whom it was purchased by the Museum of comparative zoölogy.

The sketch on the preceding page gives the entire outline, the upper and lower views of the head, and an upper view of one of the teeth.

S. Garman.

THE RUSSIAN METEOROLOGICAL SERVICE.

Although the idea that Russia is behind the other powers of Europe in civilization is true when we consider the people as a whole, yet, if we look at what has been done by the Russian government for the encouragement and advancement of science, it must be admitted that Russia plays a very important part in the total amount of scientific work accomplished by the world.

The Russians have the best astronomical observatory in the world: they have also the best meteorological observatory. The magnetical studies have been made in connection with the meteorological; and in the observations, as well as the theoretical discussions, we find the same men engaged, and the results are published side by side. In speaking of the meteorological work, one is forced, then, to at least mention the magnetical, on account of this close connection.

The Physical central observatory at St. Petersburg was founded in 1849 through the endeavors of Kupffer. The aim of this observatory was to institute physical observations and research in general, and to advance Russia in the line of physics; and, as part of the latter task, the conducting and publishing of meteorological and magnetical observations was undertaken.

So it will be seen that this observatory was not intended merely as a central office for a meteorological service; but it was to become a physical laboratory, where all sorts of physical investigations could be undertaken, and in such a manner that nothing more could be desired, that is, as far as apparatus and methods employed are concerned.

The first director, Kupffer, separated as much as possible the two departments of the observatory, as his publications show. His researches into the elasticity of metals, published in 1860, which were cut short by his death, show the nature of the purely physical investigations undertaken by him. He published an enormous mass of meteorological material in the *Annales de l'observatoire physique central*, 1847–64; also in the *Correspondance météorologique*, commenced in 1850.

In seven places hourly observations of the meteorological elements were instituted, and in six places of the magnetical elements. These and many of the observations from other stations, made a certain number of times a day, were published.

In speaking of this material, Professor Wild

said, "It is a complete mass of meteorological and magnetical observations published in detail, and therefore easily accessible to every one, and such as no other land possesses: it is of great value to the science; but it would have been much more valuable, yes, invaluable, if it was as satisfactory as comprehensive."

As at first organized, there were few under-officials in the observatory; and most of them were men who received small salaries, and were not especially qualified for their positions, — or, rather, there were no positions for men qualified, — so that the director was obliged to attend personally to all work requiring much thought. A force, then, of a director and five not specially prepared men was to conduct the work of the central office, from which were to be issued the meteorological observations, and their discussion, of a country five times as large as all the rest of Europe, through which about twenty separate meteorological institutes are distributed.

It is not to be wondered at, then, that Russian observations lay for so many years almost unused by their meteorologists. Any one who has attempted to work with magnetic observations knows that little can be done single-handed, especially if the person must also busy himself with the instruments themselves.

Through inability on the part of the director to cope thus single-handed with the great work undertaken, the meteorological service went gradually into decline. The separate stations could not be properly inspected to see that the instruments were correct, nor could the necessary attention be given to the preparation of the observations for publication. Matters finally came to such a pass, that about 1864 a re-organization of the service was agreed upon, and the establishment of forty new meteorological stations. However, the next year, and before any thing could be done, Kupffer died, and Kaemtz was called to succeed him.

This great meteorologist at once elaborated plans for the improvement and enlargement of the service; but a great undertaking of this kind goes forward slowly, and at his death, two years later, not much had been carried practically into effect.

The service, then, was in a disorganized condition when Wild took charge in 1868. Although it is probable that a great improvement would have taken place had Kaemtz lived, yet we can hardly hope that he would have placed the service in that high position which it now holds in reference to others, and which it assumed so shortly after the choosing of Wild as director.

Professor Wild doubled the corps of assistants, and made the positions so desirable and important that university men were glad to accept them, and good men from other continental countries were easily persuaded to accept places. These men were of such ability that they could undertake and successfully carry out, under the supervision of the director, any single investigations, and thus relieve the chief of that care and constant watchfulness which would have been necessary had he had less skilful assistants. The results of these labors can be seen in the papers published in the *Repertorium für meteorologie.*

But it is mainly of the Russian service as it at present exists, and especially of the meteorological observatory, that I wish to speak.

The whole establishment is composed of several observing-stations of the first order (i.e., where either hourly observations are made, or where self-registering barometers, etc., are employed), and about a hundred and thirty stations of the second and third orders, where observations are made at stated times during the day. In order to obtain an idea of the distribution of these stations, the reader must consult the chart accompanying the *Temperatur-verhältnisse des russischen reiches*, published in 1881 by the observatory.

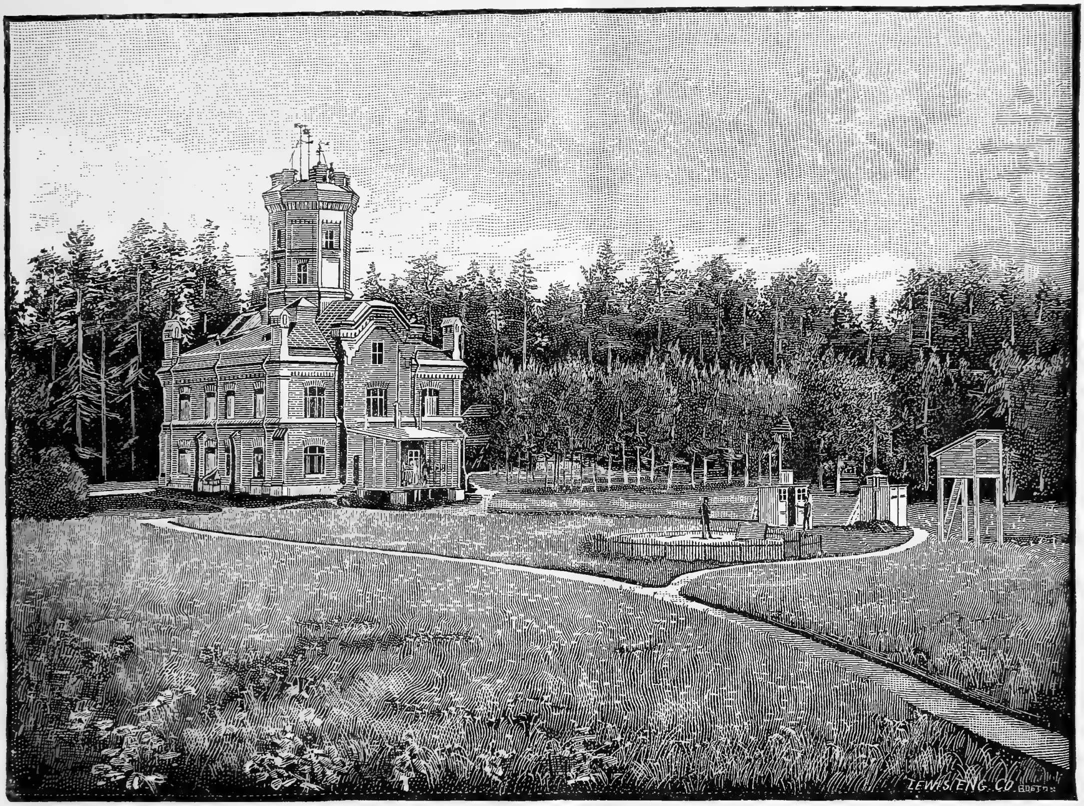
The meteorological observatory at St. Petersburg consists of two parts, — the Central physical observatory, in the city itself; and the observatory at Pawlowsk, in the country, about thirty kilometres distant. The present building occupied by the former was built about 1860, and continued to be the principal observing-station until 1877, when the other was grounded.

The building in St. Petersburg occupies a not prominent position at a little distance from the north bank of the Neva, in the western end of the city; but it has no longer the quiet surroundings that it probably had at the time of its construction, as the city is extending in that direction.

All of the work of standards, instrument-comparing, preparing matter for the printer, correspondence, supplying stations with necessities, and the general management of the whole service, is carried on here, and for eight or nine months of the year it is the dwelling-place of the director.

For the non-meteorologist, however, the only attractive feature of the institution is the large instrument saloon, where there is much fine apparatus, especially standards. The library is a very good one, and the numerous books in foreign languages show the extent to which the

Russians make use of foreign writings. In fact, very few of the books in the library are in the Russian, even when containing their own work. There is, however, a strong reaction in this respect; and before many years we may expect to receive the Russian scientific publications, not in the French and German languages, as at present, but in the Russian. This will be unfortunate for us; because the language is difficult to learn, and much of their science would be buried to us for a long time at least.



METEOROLOGICAL STATION AT PAWLOWSK, RUSSIA.

At Pawlowsk there is much of interest. It requires about an hour's time on the railway to go from St. Petersburg to this place. On the way there, the clump of trees surrounding the great Pulkowa astronomical observatory is visible; and in winter the main building itself can be plainly seen.

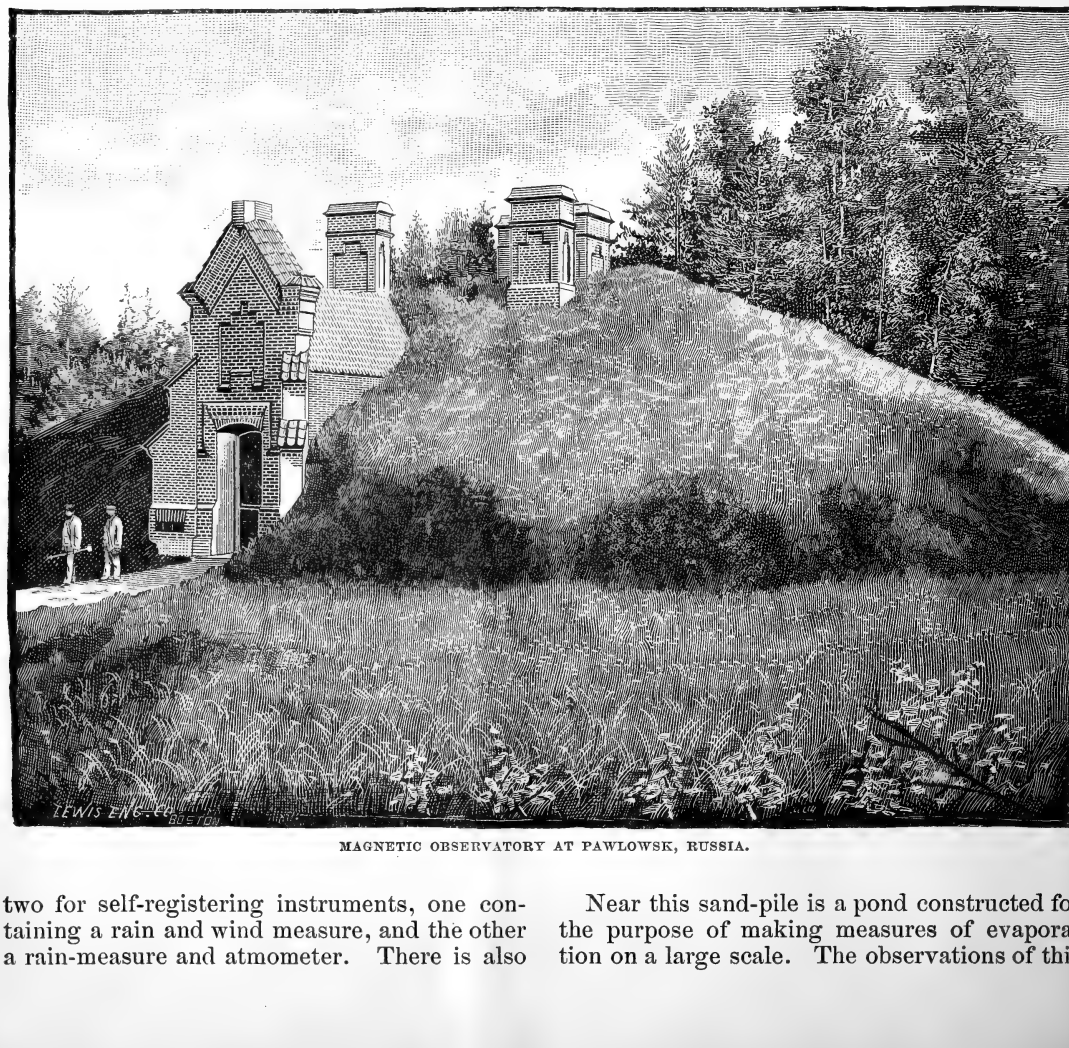
There were several reasons for the founding of this new observatory. Professor Wild had ideas that he wished to carry out, and which he considered essential for the best results: he had found the city observatory in a settled condition, and it would have been impossible to change it into such a form as he wanted. Again, the old observatory was a poor place for magnetic instruments, both on account of the unsteadiness of the instruments, and the close proximity to the iron ships that are constantly passing and repassing on the river, only a few hundred feet away. He also had the idea, which is shared by most meteorologists, that the city itself is no place to make meteorological observations; as the conditions are not the same as in the surrounding country.

This observatory is situated nearly two miles distant from the town of Pawlowsk, which lies thirty kilometres south-east of St. Petersburg. This town, although thinly inhabited in the winter-time, is filled to overflowing in the summer by the people from St. Petersburg, who want to enjoy what little summer country life they can find.

A small portion (several acres) of the park of the uncle of the present czar has been given for the purpose of the observatory, and this piece of ground has been fenced off and the buildings erected upon it. The land lies per-

fectly flat, and is mostly covered with fir trees; although, of course, part has been cleared, so as not to influence the readings of the instruments. The observatory is certainly the meteorological paradise (at least in summer); and the visitor, whether casual, or there for the purpose of study, cannot but be struck by the taste which has been displayed in its organization and construction. The whole establishment was erected at a cost of about seventy-five thousand dollars.

The accompanying illustration shows the main building from the north side. The large thermometer-shelter is seen against the building; a little to the right, through the trees, is seen the stable; and still more to the right the roof of the director's summer residence is visible. Of the smaller buildings, the one to the right is a thermometer-screen; the other another rain-gauge, and the black bulb *in vacuo* near these. Inside of the little enclosure is a sand-heap in which are buried the thermometers for measuring the earth's temperature at different depths. The instruments are placed both in a vertical and horizontal position. In order to get at the horizontal thermometers, a hole has been dug, which contains a box filled with earth, the hole being covered by a trap-door. The box can be slid from its position, and the end of the thermometer-cases exposed to view. These are then drawn out (horizontally) by the observer, and read without taking them from the hole. The vertical thermometers are not in this hole, but are drawn vertically out of the sand when read. The glass tubing surrounding the thermometers is so made that no moisture can reach the thermometer-bulbs.



MAGNETIC OBSERVATORY AT PAWLOWSK, RUSSIA.

two for self-registering instruments, one containing a rain and wind measure, and the other a rain-measure and atmometer. There is also

Near this sand-pile is a pond constructed for the purpose of making measures of evaporation on a large scale. The observations of this

kind are not, however, of a very satisfactory nature; and the pond has apparently returned to its legitimate use, viz., furnishing a home for about a million small fishes.

In no place in the world is so much attention paid to magnetic observations and investigations as here at Pawlowsk. We see in this cut the underground magnetic house, and its size can be seen by comparison with the figures in the foreground. The building consists of two chambers, separated and surrounded by air-chambers which are heated; and the heat is thus conveyed through the walls into the observing-rooms. These rooms remain at a wonderfully constant temperature. The building is quite isolated from the remaining portions of the observatory. It was here that the observations simultaneous with those of the recent international polar expeditions were made.

The whole work of this institution is scientific in the highest degree, and there is little of what we may call popular work done; but this is unnecessary, as those who would be influenced by a more evidently practical result have nothing to say in regard to the conduct of the service.

RED SKIES IN CHINA FIVE YEARS AGO.

The 'red sunsets' which have recently attracted so much attention in so many quarters of the globe, and have called forth considerable discussion in various scientific journals, both in America and Europe, recall very similar phenomena I observed five years ago, under circumstances which seem to me worth recording at this time.

During the early part of the winter of 1878–79, I had occasion to pass several weeks, engaged in geological work, along the base and among the foot-hills of the first mountain range that rises above the plain of northern China, and forms the boundary between the provinces of Chihli and Shansi. Frequently in the month of November my attention had been called to the intense coloring of the sky, and brilliant red afterglows, slowly fading away, and lasting long after the sun had set. On one occasion, Dec. 1, I left the small mountain village of Cheang-Shui, accompanied by my friend Mr. W. N. Pethick of Tientsin, for a long tramp among the hills. We travelled up the long valley, and ascended to the top of the pass commanding an extended view to the westward, over the plateau of Shansi. Although late in the day, we pushed on to the village of Tang-Cheng-Tsun, a mile and a half to two miles beyond, reaching there about sunset.

On our way back to the pass, I was continually looking backward, astonished at the brilliancy of the sky, the orange-red and peculiar brick-red colors of the horizon, and the length of time the vivid coloring remained after the going-down of the sun. How long this intense afterglow continued I am unable to say; as, on reaching the summit, we retraced our steps down what in the Cordillera would be called the cañon, and the western view was completely lost behind an abrupt wall.

All the phenomena connected with the sunset were quite similar to those recently observed in New York, except, as I now recall the scene, the colors seemed to surpass them in brilliancy.

Through the month of December I was frequently impressed with the deep red glare of the skies, and long twilights, although none of them appeared to equal in intensity the one observed from the top of the plateau. This difference I supposed was due to the view being somewhat shut off by the high ridge to the westward.

As early as November the prevailing winds in northern China blow almost continuously from the north-west, across the broad area of country covered with loess-deposits. In consequence, the atmosphere was never wholly free from fine loess-dust; a haziness being at all times noticeable in the mountains, while frequently the air was gray from the large amount of impalpable dust held in suspension. On those days when the dust was most perceptible the colorings of the skies were never remarkable, and were only fine when the lower atmosphere seemed clear and bright.

These brilliant afterglows continued at intervals throughout December and early part of the new year; the last one being noticed about the middle of January, from a small village seventy-five miles east of the mountains, where I had put up for the night on my way to Tientsin. In the following September I again visited the mountains and plateau of Shansi, but do not recall any thing in connection with the sunsets at all comparable to those observed the preceding winter. But, on the other hand, the atmospheric conditions were also wholly changed; the wind was blowing steadily from the east or ocean side; the air was laden with moisture, which was frequently precipitated in heavy rains; and the atmosphere, so far as the eye could detect, was free from dust. I can but think that the great brilliancy and long duration of the afterglow were intimately connected with loess-dust in some such way

as the recent remarkable displays have been attributed to the volcanic dusts of Krakatoa. The peculiar phenomena in the skies, like those described, were not noticed at Tientsin in the spring. This may be accounted for by atmospheric conditions being changed, and the air at this season of the year being overcharged with too much fine material derived from the dust-storms which form, during March and April, so marked a feature of the climate of northern China. I think it quite probable, however, that red skies, similar to those recently observed in various parts of the world, may at times be seen throughout the winter by foreign residents at Peking and Tientsin.

A few more words about loess-dust. During the winter referred to I was much interested in the question of the loess that was annually being removed from the land and carried out to sea, and not only was impressed with the amount transported by streams, but was led to believe that a not inconsiderable quantity was borne eastward by the prevailing winds, and finally precipitated upon the ocean. Inquiries brought out the fact, that, in the China seas, ships many hundred miles from land frequently report showers of fine material falling upon the decks, which in many cases have been wrongly regarded as deposits of volcanic dust. In conversation with the captain of the steamship China, on the passage from Yokohama to Hong Kong in the autumn of 1879, he narrated his experience in a dust-storm, while passing over the same route in the preceding spring. The storm occurred April 25, in latitude 29°, longitude 128°. It lasted twelve hours, with a heavy wind blowing steadily from the north-west. Every thing on board was coated with an excessively fine dust, which, as the captain expressed it, "was so thick that it could be taken up with the fingers like so much snuff." From the rigging, one of the sailors, under orders from the captain, collected with a knife-blade a large amount of the dust, samples of which he forwarded to London for examination. Now, I very well remember that in April the whole plain of northern China was enveloped in several severe dust-storms; two of them, at least, having a duration of three days each, and filling the air at times with dust, so as to completely obscure the sun. There is no question in my mind but that the material which fell upon the steamship came from the loess of China; and I believe that a great deal of the so-called volcanic dusts which are often reported as observed at sea are, at least in Chinese waters, derived from loess-deposits.

Arnold Hague.

THE EVOLUTION OF THE CEPHALOPODA.—I.

Cephalopods, or cuttlefishes, have structural peculiarities which make them the most favorable subjects now known for the special study of the problems and laws of the evolution of forms in time. In two of the orders the animals were shell-covered; and the shell in these is so built that it preserves, even in the fossils, the embryo, the young shell, and all its stages to the full grown. Then, passing on into old age, it shows in the senile period a series of retrograde transformations, often reversing its adult condition and aspect. This record of the entire life is fuller than any one who has not minutely studied this type can imagine from his experience in other branches of the animal kingdom. It is not only in itself a complete cycle of changes, and these of no slight or doubtful character, but the external records of the shell-structure, apertures, and other parts, are supplemented by the hard portions of two internal structures, which are preserved, and also change in accordance with the age of the shell. We have, therefore, in every well-preserved specimen, the unique advantage of being able to study the complete cycle of its individual life in three distinct sets of organic parts. We can therefore compare the changes which we observe in the individual with the modifications which the group has undergone in its progression or retrogression in geologic times with a certain completeness of the evidences, at present unattainable in any other class of animals. In the Belemnites, the third order, the shell and its parts are much less instructive; and finally, in the fourth, the Sepioidea, it is so much reduced, and so frequently absent, as to lose very largely in this respect.

The class has two sub-classes, Tetrabranchiata and Dibranchiata. These were established by Richard Owen as orders,—a purely technical difference, which does not change in any way the value of the structural distinctions as given by this eminent naturalist. The Tetrabranchiata are shell-covered; and they are represented by the modern Nautilus, the only existing genus. The Dibranchiata are descendants of the former, but enclosed the shell, and resorbed it in many forms, so that they appear as naked animals. The cuttlefishes, squid, devil-fishes, etc., are existing types. In studying these types, the author has been led to adopt a new method of characterizing the divisions, and besides the old structural distinctions, which are still available, to apply the

correlations of habit and structure to the elucidation of ordinal differences.

The class Cephalopoda is composed of exclusively aquatic and marine animals, and consequently they breathe with gills. The structures of the two sub-classes coincide with two distinct habitats which they respectively occupy. The Tetrabranchiata, like the Nautilus, were essentially littoral crawlers, though possessing organs suitable for swimming, and doubtless using them more or less for leaping and swimming.

The animal of the Nautilus has a large mantle or fleshy sac enclosing the internal organs, which can be opened around the margin, or closed, at the will of the animal. Admitting the water around the margin, they fill their mantle-cavities with water, and then, closing and compressing the mantle-sac, force it out with violence through a fleshy pipe, which is exclusively used for that purpose, and always situated on the ventral side. The reaction of the stream is sufficiently powerful to drive the body of the animal with varying degrees of swiftness backwards. The fleshy pipe is therefore an ambulatory pipe or hyponome; and we propose, in place of the old and confusing terms, to call it by this name.

The Dibranchiata change the external shell, which they inherit from the Tetrabranchiata, into an internal organ, and taking advantage of the powerful hydraulic apparatus of the Tetrabranchiata, which they also inherit, and increasing its efficiency, become, as is well known, exclusively swimmers.

The ambulatory pipe of the Nautilus causes a corresponding depression or sinus to occur in the aperture of the shell on the outer or ventral side, and its effect is also to be seen in the striae of growth throughout the entire length of the shell on the ventral side; so that we know, from these indications in any fossil, what was the comparative size of the pipe, and whether the animal was more or less powerful as a swimmer. Other indications, such as the openness or contracted form of the various apertures of different genera, exhibit with equal clearness what they could do in the way of crawling. The wide-open apertures indicate powerful arms, capable of carrying and easily balancing the large spire of the shell above: the narrow contracted aperture shows that the arms were small, and that the animal could not so efficiently balance or carry the shell in an upright position, and was therefore, according to the amount and style of the contraction, more or less inefficient as a crawler.

In studying the different types of the Tetrabranchiata, we find that there are two orders as first defined by Professor Louis Agassiz, — the Nautiloidea and the Ammonoidea, — and, further, that these divisions coincide with differences in the outlines of the ambulatory sinuses which indicate distinctions of habit general throughout each order.

The extinct Nautiloidea have large ambulatory sinuses, and were evidently capable, like the modern Nautilus, of rising to the surface, and swimming with a jerky motion; though their open apertures, as a rule, show their normal condition to have been crepitant, or bottom-crawling. The exceptional shells, which depart from the typical form in the sinus and apertures, exhibit their peculiarities in the adults, but not, as a rule, in the young, except in cases where direct inheritance can be proven to have occasioned the exception. The exceptions, then, are, in fact, the most conclusive of our proofs, since they show the power of the habitat to produce permanent changes in the apertures.

The orthoceratitic shells of this order are straight cones, with internal septa dividing them into air-chambers, connected by a tube uniting all the air-chambers, and opening into the body of the animal itself, which occupied a small part only of the whole length of the cone. This is the simplest form: and others are, the bent or arcuate, cyrtoceratitic; the loosely coiled, but with whorls not in contact, gyroceratitic; the closely coiled, with whorls in contact, nautilian; and the still more closely coiled or involute shells, the involute nautilian, in which the outer whorls may simply overlap the inner, or entirely conceal them by their excessive growth, as in Nautilus pompilius.

The Ammonoidea in their earlier forms, the Goniatites, have apertures, with a less strongly marked ambulatory sinus, but still sufficient to show that they must have had considerable powers of rising or leaping in the water, if not of swimming, like the Nautilus. In their later forms, the Ammonitinae, however, the ambulatory sinus is absent; and in its place projecting beaks or rostra are developed, indicating reduction in the size and use of the ambulatory pipe. This and the generally open apertures enable us to see that they were more exclusively bottom-crawlers than the Nautiloidea. The most interesting of the facts in this order lies among the exceptional shells, some of which must have been sedentary, and neither have crawled nor moved about with any ease; but none of these, so far as we know, seems to have exhibited a type of aperture which in-

dicated transition to an exclusively swimming habit. These shells appear in our subsequent remarks among the geratologous and pathological types.

The shells of this order have no such variety of form in the paleozoic formations as we have described in the Nautiloidea. They are close coiled, and even involute, in some of the first forms found in the Cambrian.

The Belemnoidea of the Jura had a solid cylindrical body, called the guard, attached to the cone-like internal shell, and partly enclosing it. Aulacoceras of the trias, as described by Branco, is a transitional form with an imperfect guard, which frequently contains fragments of other shells and foreign matter. This demonstrates an important link in our evidence, that this guard could only have been built by some external flap or enclosing sac, independent of the true mantle. This false mantle must have enclosed both the shell and the guard, and must have been at the same time open, so as to admit the foreign materials which Branco found built into the substance of the guard. One of the straight shells of the Silurian Nautiloidea, Orthoceratites truncatus, regularly breaks off the cone of its shell, and then mends the mutilated apex with a plug. This plug, we are able to say, is the precise homologue, in position and in structure, of the guard of the Belemnite. Barrande showed this plug to have been secreted by external organs, as he supposed, — two arms stretching back from the aperture like those of Argonauta, and reaching beyond the broken apex. The dorsal fold of Nautilus is, however, a secreting-organ stretching back over the shell; and, as the probable homologue of the plug-secreting organ of the Orthoceratites and the guard-building organ of the Belemnoidea, it enables us at once to explain how the Belemnoidea arose from the Orthoceratites, and why Aulacoceras had an imperfect mantle. This fold, which was far larger among the ancient Orthoceratites, would have been necessarily open on the ventral side, then more but not completely closed in Aulacoceras, and finally completely closed in the later Belemnoidea, and able to construct a guard as perfect as that which they carry.

The solid guard of these animals in a compact cylindrical body, such as they were known to possess, could have been only a heavy burden to a swimming animal. The Belemnoidea, therefore, were not purely natatory; but for these and other reasons, which we cannot here discuss, they were evidently ground-swimmers, probably boring into the mud for shelter, or as a means of concealing themselves while lying in wait for their prey.

The old view, that the guard could have been in any sense a 'guard' against collisions with rocks, etc., in their wild leaps backwards, is inadmissible for many reasons. The most obvious are its position as an internal organ, its solid structure, and its weight. We think it more reasonable to suppose that it might have increased the liability to injury from collisions. In tracing the Belemnoidea to the Orthoceratites we have simply continued the labors, and carried out more fully the sagacious inferences, of Quenstedt and Von Ihering.

The modern Sepioidea are known to be almost exclusively swimming types; and the more ancient, normal, flattened forms, and their descendants the existing cuttlefishes, have flattened internal shells, in which the striae of growth are remarkable for their forward inflection on the dorsal aspect, due to the immense comparative length of this side of the aperture. Gonioceras, a well-known Silurian type of the orthoceratitic Nautiloidea, has the same contours in the striae of growth on the dorsum; and if, as we think, it had a corresponding depression in the aperture on the ventral side, in similar proportion to that of other forms, the aperture must have been transitional to the internal shell of Paleoteuthis Dunensis of the Devonian, and to the more modern forms. The septa, also, of Gonioceras, have similar curves to the layers of calcareous matter in the interior of the cuttlefish bone, which we look upon as aborted and retrogade homologues of the septa of other forms. Gonioceras connects directly with a series of less compressed, straight, orthoceratitic shells; and thus the independent derivation of the Sepioidea from the Orthoceratites, among the shell-covered, coniform Tetrabranchiata, is probable. The enclosure and suppression of the shell have already been predicted, with a sagacity which commands our highest admiration, by Lankester, from studies of the embryo of Loligo; and these facts carry out his conclusions, substituting, however, the more ancient Sepioidea for the Belemnoidea, with which Lankester made his comparisons, and the hood for the two mantle-flaps which were imaged by him as the organs which enclosed the shell and formed the shell-sac. Most paleontologists have considered the Sepioidea and Belemnoidea as more closely allied; but they appear to us as two orders, certainly as distinct as, and perhaps even more widely divergent than, the Nautiloidea and Ammonoidea.

Among these two orders we recognize many

exceptional forms, — such as the Spirula among Belemnoidea, and among Sepioidea the octopods; and we think they all prove our position, that the habitat so closely accords with the structural changes of the type that its purely physical agency must be regarded as the efficient and direct cause of the correlated changes of structure which distinguish the different orders and sub-orders, and often of the exceptional genera and species. We will mention but one of these exceptional cases, in some respects the most pertinent, — the existing Argonauta, or paper nautilus. Here a thin shell secreted by the mantle, by the edge of the mantle, and by the two pairs of long dorsal arms, encloses completely the animal of the female alone, the male being naked. As a sexual organ for the protection of the eggs; as an adolescent and adult structure, originating at a late stage in the life of the individual, and not in the shell-gland of the embryo; and in its microscopical structure, — it is not a true shell, or similar to any true shell among Cephalopoda. Still, in form and position, and as built in part by the mantle, it is a homologue of a true shell, and has in part, also, the functions of a true external shell, and ought therefore to support or refute our hypothesis. It belongs to a swimming animal, and should therefore have the sinus and aperture and striae of growth as in Nautiloidea; and these it certainly has. We can appeal to this example as a most convincing exception to prove the rule that the shell is a true index of the most remarkable adaptive structures, and, among the fossils, can give us exact information of important differences in structure and habits.

The *efforts* of the Orthoceratite to adapt itself fully to the requirements of a mixed habitat gave the world the Nautiloidea: the *efforts* of the same type to become completely a littoral crawler developed the Ammonoidea. The successive forms of the Belemnoidea arose in the same way; but here the ground-swimming habitat and complete fitness for that was the object, whereas the Sepioidea represent the highest aims as well as the highest attainments of the Orthoceratites, in their surface-swimming and rapacious forms.

We cannot seriously imagine these changes to have resulted from intelligent effort; but we can fully join Lamarck,[1] Cope, and Ryder, in imagining them as due to efforts induced by the physical requirements of the habitat, and think this position to be better supported by facts than any other hypothesis.[1]

Confining ourselves to the Tetrabranchiata, which we think the most favorable for our purposes, the next problem presenting itself is whether the two orders, Nautiloidea and Ammonoidea, have had a common origin, or whether they bear internal evidence of having had a distinct origin. The embryo of all Ammonoidea, as shown by the author in his 'Embryology of the fossil cephalopods of the Museum of comparative zoölogy,' and since confirmed by the more extensive researches of Dr. Branco, is the little bag-like shell first discovered by Saemann. This is attached to the apex of the secondary shell. The embryonic bag is called the protoconch by Professor Owen; and the secondary or true shell, the conch.

There is no protoconch in Nautiloidea, as first shown by Saemann, then by Barrande, and subsequently by the author and Branco; but where it ought to have been attached on the apex of the conch, or true secondary shell, there is a scar, first demonstrated by Barrande. The view brought forward by the author, that this scar indicated the former existence of a protoconch in the Nautiloidea, has been opposed by Barrande, Branco, and several authors, on the ground that the cicatrix demonstrated the existence of a distinct embryonic form. Therefore, according to Barrande, the Nautiloidea were not similar to the Ammonoidea in their earliest stages of growth, and must have been equally distinct in origin.

Our present contribution to this discussion is simple and straightforward. We have found the protoconch in several forms of Orthoceratites, of some of which we give figures; and, further, it can probably be found on the apex of the so-called perfect shells, which have no scar or cicatrix. These were discovered by DeKoninck, and supposed by him, in his 'Calcaire carbonifère' (*Ann. du mus. roy. de Belgique*), to be fatal to our conclusion. Having no scar, they could not possibly, according to DeKoninck, have had a protoconch. When the so-called perfect apex is broken off, the observer will probably find that this apex was the shrivelled remains of a protoconch which concealed the cicatrix underneath, as in Fig. 2. There is therefore no essential difference between the embryos of the Ammonoidea and those of the Nautiloidea. There are some of

[1] A noted French writer well known to embryologists, Lacaze-Duthier, has lately asked, "Who, at the present time, supports Lamarck?" The author can answer, that some of our leading scientific men consider Lamarck's hypothesis to contain more fundamental truths than Darwin's or any other.

[1] We can also confidently appeal to Dohrn's hypothesis of change of function in support of this view, in which he shows with many convincing examples that organs have latent functions which can be developed by any change of habits, and then become predominant over the older functions, and by their reactions occasion an entire change in the structure of the organs themselves.

minor importance which we cannot discuss here. These, however, do not interfere with the facts of general agreement; and there is great probability that the shell-covered forms of all kinds which have the protoconch — namely, the ancient and modern Gastropoda, Tentaculites, and the ancient Pteropoda, and all the radical forms of Cephalopoda — had a common origin, probably in some chamberless and septaless form similar to the protoconch. Von Ihering has already designated this prototype as probably Tentaculites. No exact correspondent to the protoconch is yet known to us; but certainly Tentaculites is nearer to the protoconch of both Cephalopoda and Gastropoda than any other known ancient form.

The young of the simplest and earliest of Ammonoidea, the Nautilini, have in varieties of two species, as shown by Barrande, a straight apex, like the adult shell of Orthoceras, the radical of the Nautiloidea. We have already claimed that this fact was sufficient to prove the high probability of a common origin from a straight shell like Orthoceras for both of these orders; and we are now able to reiterate this conclusion, and to meet the objections of the great paleontologist Barrande, and his supporters, more effectually than ever before.

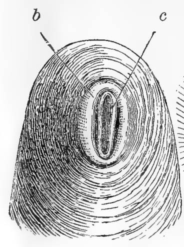


FIG. 1.

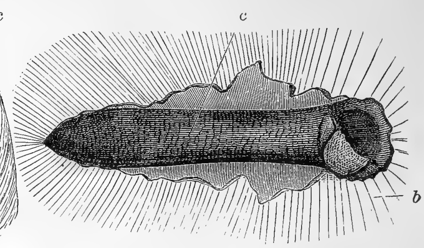


FIG. 2.

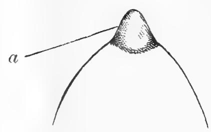


FIG. 3.

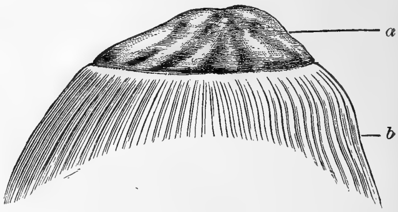


FIG. 4.

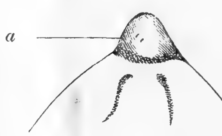


FIG. 6.

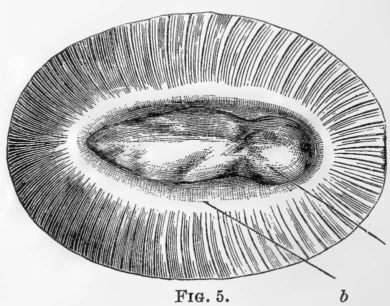


FIG. 5.

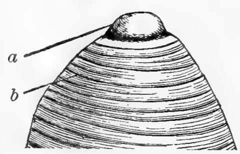


FIG. 7.

FIG. 1. — Aspect of the apex of the conch in Orth. unguis Phill., after the protoconch has been shed in the usual manner. *b*, conch or shell of the apex; *c*, cicatrix.

FIG. 2. — Aspect of the apex, after the protoconch has been accidentally broken off, fracturing the outer shell, and exposing the cicatrix. *b c*, as before.

FIGS. 3-5. — Apex and protoconch of Orth. elegans Munst. from the front, side, and above. *a*, protoconch; *b*, shell of apex.

FIGS. 6, 7. — Another individual, said to be of the same species, less magnified. *a b*, as before. The author has also, in other species, traced the striae of the outer shell on the protoconch itself, showing the continuity of the shell over this part (*a*), and completing the evidence that it must have been the shell which enclosed the embryo, and could not have been a mere plug, as asserted by Barrande (*Syst. sil.*, pl. 488).

Goniatites compressus, sp. Beyrich (*Sand. verst. Nassau*, pl. 11, fig. 4), is a shell which differs from all other Ammonoidea in an essential and highly important character. The septa have no inner lobe. The v-shaped annular lobe which occurs in all the Ammonoidea except the Nautilini is also absent in this species. What is more to the point, this shell has the sutures of a true nautiloid, since it has the dorsal saddle, in place of the dorsal lobe, of the sutures of its nearest allies, the Nautilini, and all of the remaining Ammonoidea. Goniatites ambigena Barr., of the Silurian, is a close ally of this Devonian species, and the two are the only Ammonoidea which are not truly nautilian in form. The whorls are in contact; but there is no impressed zone, and no sutural lobes on the dorsum, as in true nautilian shells. On the contrary, they are purely gyroceran forms, with rounded dorsum and sutural saddles in place of lobes. All of the Nautilini and G. compressus also have the septa concave, as in the Nautiloidea, in place of the convex character of the septa in later Ammonoidea. As doubts may disturb the mind as to whether G. compressus is an ammonoid at all, we recommend a comparison of this shell with the young of Goniatites fecundus of Barrande, which is a miniature copy made by heredity.

Bactrites is a perfectly straight form, similar to these Goniatites in very important characteristics, especially the siphon and septa.

This same genus includes straight cones like

Orthoceras pleurotomum Barr. (*Syst. sil.*, pl. 296), which are undeniably transitions to true Orthoceras in their striae of growth and position of siphon. There is therefore convincing evidence in the structures of these Cambrian shells that the Ammonoidea, with their distinct embryos, arose from the orthoceran stock, and passed through a series of forms, in times, perhaps, preceding the Cambrian, which were parallel to those characteristic of genetic series among Nautiloidea; viz., straight, arcuate, gyroceran, and nautilian.

The researches of Emmons and Marcou in this country, and the discovery of ten thousand feet or more of stratified rocks under the Cambrian by the U. S. geological survey, and the inferences of Bigsby from the extended study of Silurian and Devonian fossils, are beginning to place the probable existence of a prepaleozoic period beyond question, in spite of the really grand opposition and world-wide researches of Barrande. The study of the tetrabranchs teaches us, that, when we first meet with reliable records of their existence, they are already a highly organized and very varied type with many genera, and that the name 'paleozoic,' as applied to these first records, is a misnomer. There was a protozoic period; and the tetrabranchs, like their successors, certainly must have had ancestors which preceded and generated them in this period, but of which we are at present necessarily ignorant. Whatever the future may have in store for us we cannot now predict; but at present the search for the actual ancestral form, though necessary, is nevertheless not hopeful. We can, however, rely upon the facts of embryology, and predict without fear of failure, that, when our k owledge makes this prototypical form known, it will have a decided resemblance in structure and in aspect to the earlier stages of the shell as observed in the fossil cephalopods.

(*To be continued.*)

SCALES OF COLEOPTERA.

SOME of the more interesting forms of scales of Coleoptera described in the paper by Dr. George Dimmock, noticed in *Science*, i. **455**, are shown in the annexed figures. The scales of the carpet-beetle, Anthrenus scrophulariae, and of the museum pest, A. varius (fig. 1), resemble in general form those of many Lepidoptera, as do also the scales of Valgus squamiger (fig. 3). The scales of V. squamiger are, however, hairy, in fact, almost shaggy. The scales of Hoplia coerulea (fig. 2) vary from round to lanceolate, those of the dorsal surface being transparent yellow when viewed by transmitted light, and blue by reflected light. Those of the ventral surface are purplish, purplish red, red, bluish, and colorless by transmitted light, while by reflected light they are silvery white, with at times a tendency to metallic green. The scales of the dorsum are smooth, filled with fine reticulations (fig. 2, *d*), but those of the ventral portions and of the tip of the

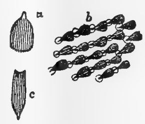


FIG. 1.

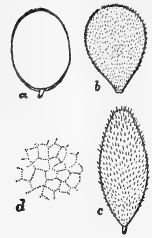


FIG. 2.

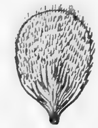


FIG. 3.

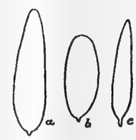


FIG. 4

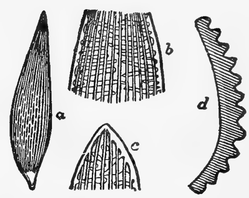


FIG. 5.

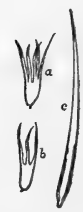


FIG. 6.

FIG. 7.

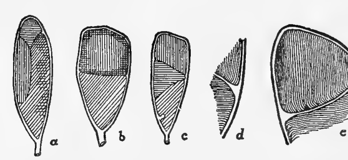


FIG. 8.

FIG. 1.—Scales of Anthrenus: *a*, of A. scrophulariae; *b*, arrangement of same on portion of an elytron; *c*, scales of A. varius. Enlargement: *a* and *c*, 100 diam.; *b*, 50 diam.

FIG. 2.—Scales of Hoplia coerulea; *a*, from elytron; *b*, from under side of thorax; *c*, from femur; *d*, fine structure to be seen in *a*, with high powers. Enlargement: *a*, *b*, and *c*, 100 diam.; *d*, 500 diam.

FIG. 3.—Scale of Valgus squamiger. Enlarged 100 diam.

FIG. 4.—Different forms of scales from Chalcolepidius rubripennis. Enlarged 100 diam.

FIG. 5.—Scales of Alaus oculatus: *a*, brown scale; *b* and *c*, portions of white scales to show cross-bands; *d*, transverse section of a brown scale. Enlargement: *a*, 100 diam.; *b* and *c*, 300 diam.; *d*, 500 diam.

FIG. 6.—Scales and hair of Ptinus? rutilus: *a* and *b*, scales from elytron; *c*, hair from elytron. Enlarged 100 diam.

FIG. 7.—Scale of Clytus robiniae. Enlarged 100 diam.

FIG. 8.—Scales of Entimus imperialis: on *a*, *b*, and *c*, vertical lines indicate blue, horizontal lines indicate carmine red, and oblique lines yellow; where two kinds of lines cross, one color is tinged with the other; on *d* ard *e* the fine lines represent the finer striation of the inner layer of the scales. Enlargement: *a*, *b*, and *c*, 100 diam.; *d* and *e*, 300 diam.

abdomen are covered with fine hairs representing the branches of the ordinary hairs of scarabaeidous beetles. The scales of Chalcolepidius rubripennis, an elaterid, are transparent brown when seen by transmitted light, but by reflected light appear bronzed blue, green, or red. Their form is seen in fig. 4. The black and white scales of Alaus oculatus (fig. 5), which give rise to the entire figuration of that curiously marked elaterid, although not of especially pe-

culiar form, are very interesting; because, in the white ones, the striations of the outer lamina, which form the corrugations seen in sections of the scales (fig. 5, *d*), are longitudinal, while the lower lamina, or lamina toward the insect, although smooth, shows transverse bands (fig. 5, *b*, *c*). In the fact of their corrugated surfaces being turned away from the insect, the scales of Alaus and of some other Coleoptera agree with the scales of Lepidoptera and Diptera. The 2–7 pointed scales of Ptinus (fig. 6), which are nestled amongst its hairs, resemble in a general way the plumules of some Lepidoptera. Most of the coloration of the well-known locust-borer, Clytus robiniae, is due to scales (fig. 7), which are of a form not rare in the longicorn Coleoptera.

The Rhynchophora or Curculionidae are the beetles on which scales most generally occur, and where they present their most brilliant coloration. The diamond beetle of South America, Entimus imperialis, often sold by jewellers on account of its brilliancy, has scales (fig. 8) and hairs which present to transmitted light various colors — usually red, blue, and yellow; often all three colors with gradations between them — on a single scale. By reflected light, or upon a black surface like that of the beetle itself, the prevailing colors are green and purple. The colors which are indicated by the direction of the lines on the figure (fig. 8 *a*, *c*) are those seen by transmitted light. When highly magnified, these scales, besides other structural characters, show a very fine striation (fig. 8, *d*, *e*), sometimes in one direction on one part of the scale, and in another direction on another part. This fine striation is probably the cause of the brilliant coloration of these scales.

All the brilliant coloration of scales of Coleoptera appears to be due to interference of light, either by fine striation, or by superposed delicate lamellae; as can be proved by wetting the scales with chloroform, when the color disappears, only to reappear as soon as the chloroform is evaporated. Most of the scales of Coleoptera contain air; and this air, together with the background formed by the coloration of the insect itself, gives rise to the various changeable hues seen in most of the Coleoptera which have scales.

MICROBES.[1]

NONE of the organic substances which form an essential part of our sustenance, and are useful in a thousand ways, can be kept for more than a few days: fermenting and spoiling, they are the despair of the economists. In this decomposition the substance becomes filled with an immense number of very minute organisms. How can a liquid, like milk or soup, free from all foreign germs, become invaded in a few hours by these innumerable legions of microbes? The first hypothesis suggested is, that all these organisms are the result of the decomposition, and that they are produced spontaneously at the expense of the altered substance. This is the theory of spontaneous generation, so vigorously maintained by Pouchet; and it is certainly one of the greatest of Mr. Pasteur's good offices, that he has refuted one by one the arguments of the supporters of this attractive theory, pursued them to their last defence with his invincible logic and his unexceptionable experiments.

The fermentation is produced by the microbes; and these, by a wonderfully rapid propagation, are derived from germs carried by the air, or adhering to the vessels which hold the fermentable liquids. The diligent researches of Mr. Miquel show that the comparatively pure air of the suburbs of Paris holds from a hundred and fifty to a thousand living germs per cubic metre. In a hospital at the centre of the capital, each cubic metre of air contains from five thousand to thirty thousand, according to the season. Although these figures appear prodigious, they are nevertheless very small, compared to the number of spores which cling to all the solid objects surrounding us. A simple cleansing is powerless to remove them: only fire or strong antiseptic solutions can destroy them. A fermentable liquid can be preserved indefinitely if it is protected from all microbes; but it is easily seen, after what we have just said, how difficult it must be to obtain this perfectly insulated state. All these lower vegetable types are found in two forms, — 1°, the vegetative or active form; and, 2°, the passive form, that is, the spores, which play here a part analogous to that of seeds in plants.

In the active state most microbes show little endurance; many species cannot stand a drying of any duration; and in moisture a temperature of 70° to 80° C., continued for two or three hours, destroys them almost without exception. Spores are more hardy: boiling water does not kill them; but, for this purpose, water must be heated to 120°, 130°, and even 150°. When dry, the spores do not succumb to a temperature below 180° to 200°; and, according to Mr. Fricz, cold of 110° has no effect upon them. To disinfect clothing without burning; would, then, be an impossibility, if, fortunately, Mr. Koch had not discovered that the germs cannot resist the action of a continued current of steam at a temperature of 100°.

It is peculiarly difficult to protect a liquid from all germs, or to destroy all those which have penetrated it; however, it is possible, and the liquid is then said to be *barren*. Certain soups are prepared in this way that they may be sown with very small particles of substances containing the microbes to be studied; and thus the desired species obtained, to the exclusion of every other. Laboratories devoted to these studies annually distribute hundreds and thousands of litres of these soups.

The organisms which here claim our attention belong to three families, all allied to fungi, — moulds, yeasts, and microbes proper. Each kind of fermentation is produced by a certain species of these small organisms, and takes place only if the species in question is present in the liquid, from the beginning of the fermentation, in sufficient numbers not to be

[1] By Dr. H. FOL of Geneva. Translated from the *Journal de Genève*.

choked by other species. Thus the mycoderm of wine is found in abundance in the flower of the bitter grape, and is naturally scattered in the must which flows from the press. In Japan the vine grows with wonderful rapidity, and bears magnificent grapes; but the mycoderm is lacking, and the fermentation produced by the other microbes yields only an undrinkable liquid. The bakers and brewers know very well how to introduce into their dough and must the species needed. Without microbes, milk would not curdle, cheese and vinegar would be unknown; the vegetable *débris* would not decompose, and there would be no loam. Some one has calculated that a gram of soil contains a million of these little creatures. We are so accustomed to associate the word 'microbes' with the most dreaded diseases, that we lose sight of the important part they play in nature. We can confidently say that their suppression would completely overthrow the present order of things.

The power of causing fermentations is certainly one of the most curious phenomena which these lower vegetable types present. This power belongs only to certain species. Mr. Pasteur was the first to discover that certain microbes live in the air, and breathe like animals: these do not produce fermentation. Others live only when protected from the air, and cause fermentation in the matter which contains them. To these two classes there has recently been added a third, amphibious microbes, simply vegetating while in the air, and producing fermentations only when the air is withdrawn. Fermentation thus seems to be a kind of respiration. The yeasts decompose liquids in order to obtain products rich in oxygen, which take the place with them of respirable air. These facts are highly important in explaining the mechanism of diseases.

In short, from a practical point of view, we may divide microbes into three classes, — those which are useful, those which seem to have no effect, and those which are positively harmful. We have already mentioned the first class; the second are very numerous; for, to say nothing of the many species which inhabit all the recesses of nature, and concern us only very indirectly, we undoubtedly support quantities of them in the cavities of the surface of our bodies and of our digestive canal. Nothing equals the astonishment and confusion of very solicitous persons, when, by a turn of the hand, the micrograph shows them all the various forms which live at their expense. They are all kinds, from the harmless Spirillum in the saliva to the Leptothrix, which is the most active agent in the decay of teeth. But all this is on the surface: the interior of our bodies is completely free from them; and it may be said that in our organization every means is taken to defend the entrance to the organs from ordinary microbes, and to remove them if they succeed in forcing entry. There is, however, a certain number of species which have the sad privilege of being able to penetrate and support themselves in the body of a subject predisposed to receive them. The microbe of septaecemia enters only through an open wound, while those of tuberculosis and leprosy attack directly the lungs or mucous membranes of the persons afflicted. The surfaces of the lungs and of the alimentary canal seem to be the customary points of attack for the organisms which cause various infectious diseases.

Our organization is like that of a civilized nation, whose citizens are represented by our cells. The skin becomes broken (the wall of China discloses a breach), and immediately there are hordes of savage microbes which enter, at strife with the national soldiers (our cellular tissues). The microbes multiply, and scatter around a poisonous liquid; the cells combine, and try to starve their dreaded enemies and to repair the breach. The battle-field is small; but the victory is warmly contested, and the sight has its exciting aspect. The result of the struggle depends on the number of combatants and on the energy of the competing forces. The antiseptic treatment of wounds, as at present skilfully used by Professors Julliard and Reverdin, and Dr. A. Reverdin, aims to reduce as much as possible the number of microbes which enter, and to retard their development; for no one familiar with the subject would think it possible to entirely exclude them. How interesting it would be to trace the events of the contest between the organism and its invaders in the case of an epidemic disease! Science, we hope, will soon be in condition to give us this history.

The diseases which have been traced with certainty to parasites are as yet few in number: they may be counted on the fingers. To discover the nature of a disease, there must be a uniformity of experiments and evidence, of which the public, and even the majority of specialists, take no account. Nothing is easier than to examine with a microscope small parts of the various organs of a dead body, and attribute the fatal disease to the microbes found under these circumstances. These would-be discoveries, soon disproved, have only the effect of causing the public to mistrust useful investigations, and cast undeserved discredit on serious work performed in the most methodical manner. To know a parasitic disease, it is not enough to have seen the pathogenic microbe: it must have been removed from the other microbes, and cultivated through a long series of generations in sterilized soups; animals must be inoculated at various times with these pure types, and each time all the symptoms of the disease whose cause is sought must be observed. In this way Mr. Koch has revealed the microbes of charbon and tuberculosis; and these discoveries have been granted to science, after being examined by a number of investigators, among them Professor d'Espine. Long and very careful cultivation was necessary to show, after Dr. Haltenhoff's interesting paper on this subject, that the juice of the *jequirity* owes its extremely virulent properties only to the microbes which it contains. We know quite satisfactorily the organisms which produce leprosy, erysipelas, and symptomatic charbon; but for diphtheria, typhus, intermittent fevers, and many other diseases, the agents are still undiscovered.

Intermittent fevers afford a good example of how easily errors arise and spread. They were at first, and

without sufficient evidence, said to be caused by the palms, — comparatively high vegetable types, perfectly innocent of the crime of which they were accused. Late investigations point to a bacterium of elongated form as the cause, but the proofs are still insufficient. To learn to recognize the enemy is certainly the most necessary thing to be done, but it is only half the task: we must then learn to resist it. The more or less effective means of combat which have been employed up to the present time have aimed, 1°, to prevent the dissemination of dangerous microbes; 2°, to make the organism unsuitable for the propagation of the intruders; 3°, to retard, as far as possible, the growth of those which have entered, in order to give the organs opportunity to throw them off. The first of these measures engrosses the attention of the hygienists: hospitals, quarantines, and disinfectants are among the means employed. I will not enter upon a subject which touches so many disputed questions, but will confine myself to noticing certain facts and to rectifying certain very wide-spread errors. Regarding infection, the nose is a poor guide; for the experiments of Mr. Miquel show very distinctly that substances in a state of putrefaction, so long as they are moist, do not emit living germs. The water of the Paris sewers holds eighty million microbes per litre; and yet the air of the sewers contains only eight hundred or nine hundred germs per cubic metre, about one-tenth the number found in a hospital. By inoculating a rabbit, it was shown that these germs are perfectly harmless. The moist earth does not give out living organisms to the atmosphere. On the contrary, the dust of our rooms, which we do not at all mistrust, shows about two millions of these living germs per gram. The bacteria of intermittent fevers, which vegetate in the soil of the Roman Campagna, begin to spread in the air and to become dangerous only when the soil, dried by a scorching sun, is raised by the wind in the form of dust. It would be easy to multiply examples, and to prove, that, in point of hygiene, we must be guided by sense rather than by smell. We have as yet but begun this kind of study; for how does this total number of germs which the air or water holds interest us? We would prefer to know the number of dangerous germs. The proportions would doubtless be very different from those which concise analysis affords.

Until we are better informed, we shall do well to push cleanliness to an extreme, and especially to put little trust in disinfection. The number of subtances which are less injurious to man than to micro-parasites is very small. The best disinfectant is perfectly useless if too weak a dose be used. For each of these substances there is one proportion which will destroy the germs, and another which will arrest their vegetation but not destroy them. This last dose is the one with which we are generally obliged to content ourselves. The experiments of Mr. Koch and Mr. Miquel show that the narcotic effect begins to be effective on microbes only when the substance in which they are vegetating contains, among a thousand parts, 95 parts of alcohol, or 70 of borax, or 10 of salicylate of soda, or 3.2 of phenic acid, or 5 of quinine, or 0.6 of bromine, or 0.07 of bichloride of mercury, or 0.05 of oxygenated water. Certain of the substances indicated are useful in these doses; while others, as bromine, are impracticable. But especially let us not forget that the result is not a radical disinfection: it is merely a momentary weakening. Is it still needful to insist on the uselessness of too mild doses? We are constantly seeing phenic acid used at less than one in a thousand parts with the sole effect of creating a mistaken sense of security. Let me mention another almost unknown antiseptic: essence of terebinthine, according to Mr. Koch, arrests the vegetation of microbes in a dose of $\frac{1}{75000}$, a quantity easily endured by man.

All these hygienic precautions are bristling with difficulties. How convenient it would be to let the microbes live and to protect our bodies from their influence! Unfortunately we know but one way to effect this: it is based on a remark, made long ago, that certain diseases can be retaken only after many years, and that this freedom may be obtained by contracting the disease in a very mild form. This is the principle of vaccination, and also of inoculation, employed by Mr. Pasteur on certain animals. The matter inoculated contains the microbe of the disease from which we wish to protect the subject, but modified by a special cultivation: it is a virus weakened according to the methods of Mr. Toussaint and Mr. Pasteur. We touch here upon a question, at present much contested, in regard to the regularity of specific forms of these very low vegetable types. Mr. Zopf and the school of Munich believe that the most harmless species can, under certain circumstances, be changed into dangerous ones, and *vice versa*. The school of Berlin thinks that artificial modifications are only transient and momentary, and that the species may be considered invariable. However this may be, it is certain, that, if the inoculations of Mr. Pasteur have no great practical importance in their present form, they at least have a considerable theoretical value. We may hope that the time will come when it will be possible to vaccinate for all diseases which can seldom be taken a second time. Who knows if it will not end by discovering the nature of the influence which the parasitic invasion exerts on the tissues of our bodies, and in obtaining the same result in a more direct way without inoculation? When we consider the progress of science in the last half of the present century, we venture no longer to answer, 'Impossible.'

THE WATER-PORES OF THE LAMELLIBRANCH FOOT.

IN 1817 Cuvier showed that in Aplysia there was a closed vascular system, and claimed the same for all Mollusca. His view was followed till 1845, when Valenciennes and others described in many lamellibranchs pores which passed through the foot to introduce water into the lacunar tissue, where the blood circulates. This view found general acceptance, and

was taught by Siebold, Huxley, Gegenbaur, Semper, etc. Recently discussion of the subject has been re-opened by the appearance of numerous papers. Mr. Justus Carrière in several papers maintains that no *pori aquiferi* exist in the lamellibranch foot. Hermann Griesbach, last spring, in a careful paper (*Zeitschr. wiss. zool.*, 38), reviewed the whole subject, studying by sections and injections, and concluded that the molluscan vascular system was not closed, that the blood wandered in the lacunar tissues of the body-cavity, that large lacunar spaces communicated directly with the exterior through aquiferous pores in the foot, and that these pores were for the reception of water to be carried out through the Bojanus organ. He figures sections of Anodonta where the surface-epithelium of the foot bends up into the opening of the pores (there are three in Anodonta), and fades out as the pore opens into the lacunar body-cavity. During last October two quite independent papers appeared simultaneously upon the other side. Dr. Cattie, in *Zool. anzeiger*, vi., No. 151, p. 562, claims to have cut a complete series of about twenty-five hundred consecutive transverse sections through the foot of Anodonta. In no one of these was there any break in the epithelium. He has studied twenty-three species, and in no one finds the least trace of aquiferous pore. Dr. Th. Barrois, in a private imprint from Lille, dated Oct. 30, 1883, arrives at the same results. He discusses the work of Carrière and himself, and finds that they have studied most of the forms where the presence of aquiferous pores has been claimed, and in every case find pores absent, or in such position that it seems they are either connected with the functional byssogenous organ, or, where such is absent, in the aduct, with the remnant of the same. Barrois sums up his views thus: no pores exist for the introduction of water into the circulation; the only pores of the foot are those connected with the byssus organ, which never communicates with the interior of the foot. The blood may have water introduced into it, but this must be effected by osmosis, or in some manner not now to be discussed. H. L. OSBORN.

THE BORDERLAND OF SCIENCE AND FAITH.

Walks in the regions of science and faith: a series of essays. By HARVEY GOODWIN, D.D., Lord Bishop of Carlisle. London, *Murray*, 1883. 310 p. 8°.

Natural law in the spiritual world. By HENRY DRUMMOND, F.R.S.E., F.G.S. New York, *James Pott.* (Apparently sheets of the English edition.) 414 p. 12°.

THE 'science' of these regions is of course physical science; the 'faith' is the theistic and more specifically the Christian faith. These 'walks' are taken along the borders of the two. Normally, the course of this journal of science lies quite away from this borderland, which, indeed, has not always been an agreeable road for a scientific man to travel. Of late, however, a better understanding has made it pleasanter than it was for the peaceably disposed naturalist. And the Bishop of Carlisle, a trained mathematician as well as a divine, whose thoughtful essays are essentially irenical, is an instructive companion in an excursion "through that land which belongs exclusively neither to science nor to faith, but appertains more or less to both." A book "which opens with an essay on the connection between mechanics and geometry, which closes with a funeral sermon preached in Westminster Abbey," and the larger part of which had already appeared in widely read periodicals, — some of the articles being in fact, though not in name, of the nature of critical reviews, — hardly need be, and could not well be, reviewed in our journal; yet we are free to give a brief account of it, enough to indicate its lines of thought.

The first essay, on the connection between mechanics and geometry, is a modified reprint of a paper which was published almost forty years ago. The point made is, that these two sciences are essentially identical, being developments in different subject-matters of the selfsame ideas. The moral is, "that all demonstrations tend to merge in intuition, and that human knowledge, as it becomes more clear and more thorough, converges toward that absolute intuition which is the attribute of the Divine Mind." This idea is further worked out in the second essay (entitled 'The unity of nature, a speculation,' which appeared in the *Nineteenth century* in 1879), in which it is argued, that as the schoolboy begins by painfully proving the simpler theorems in geometry, and ends by perceiving that they are really self-evident, and that as all the propositions of Euclid appeared intuitively true to Sir Isaac Newton, "it is quite conceivable, by merely extending in imagination the powers of which we have actual experience, that all geometrical truth in any department might exhibit itself without intermediate steps of demonstration to a mind of sufficient acuteness, when the appropriate definitions had been given. . . . To a mind like that of Newton, I should imagine that the principles of mechanics would present themselves almost in the same self-evident light as those of geometry." And "that possibly, as the truths of geometry help us to realize those of mechanics, we may use the truths of mechanics to help us to realize some of the truths of the more subtle sciences, say, even that of biology." And the speculation, fortified and illustrated by mathematical analogies, goes on

to the conception, that "there may be a principle or law from which the existing order of physical life, with all its apparent anomalies [and its manifold diversities], flows as a necessary result," the knowledge of which, "if attainable, would exhibit to us the order of living nature as one consistent system, free from exceptions and anomalies."

All this, and indeed all the volume, proceeds on lines quite accordant with those of the purely scientific evolutionist. Moreover, in thus regarding intuition as a kind of acquisition or development, the theologian joins hands with the agnostic evolutionist, although they are moving in opposite directions. But the latter doubts, to use the words of one of them, "whether the law-governed mind of man is not itself the highest form of mind." The former, accepting "the admission which must be made by all parties of the co-existence of fundamental unity with almost unlimited diversity," and of inexplicable anomalies, endeavors to show, through mathematical analogies, that the existence of man may involve "the possibility of snakes, as truly and as really as the existence of elliptic motion involves that of parabolical," and "that a mind higher than human might see in the definition of man the possible existence of useless organs, both in man and in other creatures." At the close of the essay, descending from pure speculation of what may be, to more scientific considerations, his idea may be gathered from the following condensed abstract: —

"Let it be granted that all living beings have been developed according to some law, not necessarily known, or even capable of description in words, but still a real law of development; does this give us all the elements necessary for the solution of the life problem? If we say *yes*, do we not run into the mistake of a beginner who fancies that he can solve a problem of motion round a centre when he has been told what is the law of force? Is it not necessary to know the conditions of projection, the initial circumstances of motion or development? And may not this portion of the data be quite as important as the knowledge of the law of force? It seems to me that they who are most anxious to establish the principle of evolution should be the most ready to perceive the necessity of taking into account the consideration of initial circumstances. . . . A quantity of protoplasm with an assumed power of development will not account for existing forms of life, without the additional hypothesis of some causative power to determine the initial circumstances. Given an original germ, and given some power which shall direct the particular original cause of the development of that germ, and the whole subsequent development is conceivable: but the germ and the law of development left to themselves may be as insufficient as the particle and the law of attraction. . . . We have seen that the parabola, the ellipse, and the hyperbola are all possible curves for a particle moving round a centre of force. Only one of these curves — namely the ellipse, and only the ellipse under the condition of small eccentricity or approximate circularity — can suffice for the orbit of a planet which shall be the home of the highest form of life, namely, that of man. . . . The original conditions of motion, the initial circumstances as a mathematician would call them, must have been delicately adjusted in order to select, out of all possible forms of orbit, that one circular or nearly circular form which is compatible with the existence upon the earth's surface of beings like ourselves. May we not infer from this a similar necessity of original delicate adjustment in the process of the evolution of a highly organized creature from a protoplasmic germ?"

The third essay, entitled 'God and nature,' is mainly the development and application of a point made in a university sermon, which the author thought had been overlooked (but perhaps it really passed unnoticed because it is so obviously true), namely, that "all physical science, properly so called, is compelled by its very nature to take no account of the being of God: as soon as it does this, it trenches upon theology, and ceases to be physical science." And so, coining a discriminating word to express this, he would say that science was *atheous*, and therefore could not be *atheistic*. Intrenched in this position, he sharply criticises, as unscientific, Haeckel's denial of the existence of purpose in nature, and comes down upon Professor Seeley for his rash statement (in 'Natural religion') that 'science opposes to God, nature.'

In the fourth essay, 'The philosophy of crayfishes,' the text is supplied by Mr. Huxley's well-known lecture upon these little crustaceans, which lecture, the bishop insists, "leads the mind of the reader, and, as it would seem, intentionally, beyond the region of natural history into the domain of philosophy, and even of divinity." In that domain the bishop is a match for the naturalist: at least, he is able to verify an old prediction of Huxley's, that the evolutionist need not expect ever to drive the teleologist out of the field. Indeed, it cannot be easy to dislodge a teleologist who is so far-sighted as to "have great doubt whether we can properly speak of final ends at all, unless we embrace in our conception the whole cosmos." To Huxley's favorite line of remark that there is no great good in "demonstrating the proposition that a thing is fitted to do that which it does," and that it is "merely putting the cart before the horse to speak of the mind of a crayfish as a factor in the work done by the organism, when it is merely a dim symbol of a part of such work in the doing," the bishop replies, that the importance of demonstrating a proposition depends upon the point of view

from which the proposition is regarded; that the assumption made, "that the preservation of the individual and the continuance of the species are the final causes of the organization of an animal," is quite on a par with the old-fashioned teleology which is nowadays justly reprobated; that, at any rate, the pleasure which the crayfish apparently takes in watching for and capturing his prey is something quite distinct from 'work done by an organism;' and that, "if pleasure of some kind be denied to the crayfish, contrary to all appearances, I do not know at what point in the scale of animal life pleasure is to be admitted as a factor. If to speak of mind as a factor in work done be an absurdity in the case of a crayfish, is it not an absurdity in the case of a dog, or even in the case of a man?" And he proceeds to vindicate the delight of existence as one of the ends for which animals exist.

This idea, and the vindication of the mind of brutes, have a prominent place in the next following essay, on 'Man's place in nature.'

'Law, physical and moral,' is the topic in the sixth essay, in which a passage from Hooker's 'Ecclesiastical polity' is set over against one from the Duke of Argyll's 'Reign of law.' We need not continue our analysis, which is already longer than was intended: indeed, there is less occasion to continue; for the remaining articles, being popular addresses reproduced, are less thorough, however sensible. Even the last essay, on 'Evolution and evolution,' and the appreciative funeral sermon for Charles Darwin preached in Westminster Abbey on the Sunday following his burial there, need not detain us.

The noteworthy thing, to which this volume adds its testimony, is this: that thoughtful churchmen are following the example of thoughtful men of science. They are accepting the scientific principle of evolution as a working-hypothesis, — trying it, as naturalists and physicists have done, in their several lines of research and thought, and with somewhat similar results. The new science is accepted with complacency, if not with welcome, by the discerning. The questionable philosophy, in which it has too often been dressed, is examined and exposed.

THE second book named above appears to have excited considerable attention in England. Like the volume we have just noticed, it is an excursion into the borderland of science and faith, but with a difference. The divine is the more scientific, the layman and naturalist (for such we take him to be), the more homiletical of the two. The one picks his way along the ground with firm but cautious and carefully chosen steps: the other soars into the air. The one discriminates between science and faith, and in his book guards rather than enters upon the field of morals: the other seeks to identify the two, and in a novel way. He has discovered that natural laws, meaning the principles of physics and biology, extend to the spiritual world, and help us to understand it. He does not mean that there are analogies between the two, which may be profitable for instruction, but identities; that 'in the spiritual world,' to use his own figure, 'the same wheels revolve, but without the iron.' And the laws to which he refers are the principle of continuity, of conformity to type, action of environment as causing variation, the adage *omne vivum ex vivo*, possibly even gravitation, if there be any thing for it to act upon; and, if there is nothing for these laws to act upon, "it is not the law that fails, but opportunity." We cannot look upon this as any great improvement upon Swedenborg's 'law of correspondences;' and, as the helpfulness of the book is entirely upon the religious side, we need not further notice a volume which attracted us by its title, but which we find to be morally edifying rather than scientifically satisfying.

BACTERIA, AND THE GERM-THEORY OF DISEASE.

On the relations of micro-organisms to disease. The Cartwright lectures, 1883. By WILLIAM T. BELFIELD, M.D. Chicago, *Keener*, 1883. 131 p., illustr. 24°.

Bacteria, and the germ-theory of disease. Eight lectures by Dr. H. GRADLE. Chicago, *Keener*, 1883. 4+219 p. 8°.

DR. BELFIELD's little book is cheaply gotten up, and, beyond the possession of a few poor woodcuts, seems to be his original lectures, four in number, delivered before the Alumni association of the College of physicians and surgeons in New York in February, 1883. Even the phraseology of the lecture-room is apparently preserved throughout, and is sometimes decidedly more forcible than polite. Nevertheless, these four lectures, making in all about one hundred and thirty pages, give an admirable summary of the germ-theory of disease as it stood a year ago. Beginners or casual readers, perhaps, will not find the book diffuse enough; but pathologists and biologists will prize it for its lucidity, crispness, and keen discriminations.

After a careful perusal of these lectures, one finds himself impressed with the author's ability to go behind the returns, to draw the line between good and bad work, to catch or to predict the drift of things; and this is the peculiar merit of the book. Indignant at the attitude of some American physicians, Dr. Belfield treats their shallow objections with deserved contempt, sometimes even with harshness; but he preserves throughout the critical insight which might be expected of a follower of Tyndall and of Koch, and holds very fast indeed to that which is good.

To biologists it is of great interest to observe that pathologists are passing beyond the 'germ' theory, and are looking towards the unexplored country of unorganized ferments, ptomaines, etc., for the sources of disease, precisely as they themselves have gone thither to search for the causes of fermentation, of cellular digestion, and for many of the more intricate phenomena of physiology. The future of cellular biology seems to lie in these obscure ferments and ptomaines, affording a golden opportunity for the physiological chemist.

Dr. Belfield states his subject summarily as follows (p. 31): —

"Bacteria then, which, by virtue of their ubiquity, are in constant and frequently recurring contact with the animal body, are, like other minute bodies, organized and unorganized, frequently introduced into the body through solutions of continuity of the integuments, or through intact skin and mucous membranes, particularly by way of the lungs.

"The burning question in pathology to-day is, in what degree are the various species of bacteria, present in human tissues during certain morbid conditions, to be regarded as the cause of the morbid processes with which they are respectively associated?"

If we look for his answer, we find farther on that investigations carried on with rigid exactitude justify us in accepting provisionally the causal relation in some degree, but not so far as to exclude other like causes.

Illness may be caused by the not living products of putrefactions, as well as by the living organisms which abound in and probably produce putrefactions. But in the latter case the disease may be farther extended to fresh, healthy individuals by infection: in the former it cannot be. This points, in the one case, to a self-perpetuating cause; in the other, to one of limited powers. Moreover, good evidence exists that the boiled products of putrefaction which may produce illness owe their septic action to substances of obscure composition (ptomaines?) manufactured by the bacteria of putrefaction. This line of thought leads to the important conclusion (p. 42), —

"Hence we are logically driven, by all this work, to the belief that septicaemia implies the introduction into the animal either of living bacteria, or of a substance which has acquired noxious properties through previous vital activity of these organisms.

"More recent experiments have demonstrated, however, that the etiology of . . . septicaemia is by no means restricted to putrid infection. [For it was noticed by Schmidt that] the introduction or production in the blood of fibrin-ferment in considerable quantity produces effects identical with those of putrid infection — septicaemia."

It has since been asserted that pepsin and trypsin produce similar effects. If so, we may find eventually a cause behind the bacteria, — a fibrin-ferment-liberating cause (p. 44): —

"It would appear, athough not for all cases demonstrated, that the . . . features common to the various forms of septicaemia are attributable to the rapid liberation of fibrin-ferment in the blood; and that any agent — organized or unorganized, putrid or fresh — capable of effecting such liberation may induce the disease."

So with the cause of suppuration. Belfield looks even beyond the germ-theory, beyond the bacteria involved, and with the eye of a biologist perceives that (p. 51)

"Suppuration must be regarded, then, as indicating the presence of an element foreign to the living animal cells; which may be induced directly [as by the introduction of a powerful irritant, e.g., Croton-oil], or indirectly as an incident in the life of various fungi [e.g., bacteria]. . . . Practically, we may regard acute suppuration as proof of the access of external irritant matter, organized or unorganized."

Antiseptic surgery is then easily defined. It is not a hissing spray, nor (p. 60)

"Simply a question as to the relative anti-bacterial properties of this, that, and the other so-called antiseptic agents. It is an attempt to prevent the entrance into, as well as the formation within, a wound of all substances, organized and unorganized, which can interfere with cell-nutrition."

Enough has been said to show the spirit of these lectures. They take a broad but thoughtful and critical view of the various questions involved, treating the scoffers who speak without knowledge as they richly deserve, and taking a rather conservative view of the work done in the direction of protective vaccination; displaying everywhere the thorough training of a German laboratory, and closing with a moral which all scientific men and all believers in rational medicine will do well to read, mark, and inwardly digest (p. 114): —

"And when we consider the problems already half solved, the questions to whose solution the way appears open through the same methods already successfully applied to anthrax and tuberculosis, we may hope for results to which present knowledge shall seem

a mere introduction. But these results can be secured only by earnest, skilful, continuous experimental investigation, which is practically impossible without pecuniary support. In France and Germany such support is liberally supplied by the government; in the United States, where human life is certainly as valuable as there; where live-stock interests are already greater than in these countries combined, and must multiply many fold in the immediate future; where a single infectious disease of cattle has caused the loss of $20,000,000 in one year, and a single disease of hogs the destruction of $30,000,000 in the same time; where infectious diseases are so prevalent among live stock that the fear of infection has closed European markets against American meat and cattle — the government of this great commonwealth, which advances enormous sums for local river and harbor improvements; which sends expensive commissions over the world to observe the transit of Venus or of the moon, or to find an open polar sea; and engages in other undertakings of purely scientific interest, has not yet made one judicious, systematic, liberally supported inquiry into the possibility of acquiring protection against pleuro-pneumonia, hog-cholera, and other devourers of the national wealth. A glance at the imperial German health bureau and its work during the last four years, and a mental comparison of the pecuniary resources of Germany with those of the United States, inspire the hope that we shall not always lag so far behind in matters which appeal to the tenderest spot of the American anatomy — the pocket."

Dr. Gradle's book is made up of eight lectures delivered in Chicago, and is published on a more ambitious scale than are those of Dr. Belfield. For the beginner, or for one who is neither a pathologist, biologist, nor physiologist, this book is the more suitable. Its style is diffuse — not always, however, with a gain in perspicuity; and its index, its references to authorities, and its evident intention to give to all sides a fair showing, are features to be specially commended.

In these lectures we have, in fact, rather the report of the evidence than the judge's charge to the jury. We miss that critical and even judicial flavor which is so pleasant a feature of Dr. Belfield's book; and on that account we must consider the latter more suitable for the connoisseur; the former (Dr. Gradle's), for the beginner or the casual reader.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Yellowstone national park. — During the season of 1883 Mr. Arnold Hague began work in the Yellowstone national park, preliminary to a series of careful and systematic observations which are to be prosecuted in this field through a number of years. The geysers are to be made the subject of minute study; and the volcanic rocks, so abundant at numerous points in the park, will be examined in detail, not only as regards their geologic relations, but also in regard to their structure and composition. The field investigations in the park during the past season were confined mainly to the preliminary examinations necessary to determine what geologic and physical problems have to be solved, and to ascertain what thermal changes had taken place since the observations of 1878 recorded by Dr. Peale. Mr. Hague's party was constituted as follows: Mr. Arnold Hague, geologist in charge; Messrs. Joseph P. Iddings, W. H. Weed, George M. Wright, and C. D. Davis, assistant geologists; Dr. William Hallock, physicist; Mr. W. H. Jackson, photographer, with an assistant; Mr. Roland Holt, volunteer assistant; and cook, packers, etc.

Geologic work. — Mr. Hague took the field the latter part of July, outfitting at Bozeman, Montana. Work was begun in the park at Mammoth hot-springs early in August. From this point, slow marches were made to the upper geyser basin of Fire Hole River, to allow of a geologic reconnaissance of the route followed. At the latter locality a permanent camp was established until the last of August. In the mean time a hurried trip was taken to the Shoshone geyser basin and the Heart-lake basin, for the purpose of comparing them with the geyser basins of the Fire Hole River, and to note what changes have occurred during the past five years. While on this trip, Mount Sheridan was ascended. Mr. Hague thinks that this mountain, from which a fine view of the surrounding country was obtained, is a volcanic crater, which has been so greatly modified by glacial action that its true origin has been obscured.

Camp was moved from the geyser basin to the Great Falls of the Yellowstone, Sept. 1, and kept there until the 19th. While at this point, the structure of the Mount Washburn was examined, and a trip made to the head waters of the Gardiner and Gibbon Rivers. The region of the Grand Cañon was also investigated, and the bottom reached at four different places. The Grand Cañon is an admirable place to study the decomposition of rhyolitic flows, the weathering of which has produced the brilliant coloring for which the cañon is so justly celebrated. A trip was also made from this camp to Steamboat Point, on Yellowstone Lake, from which point the ascent of Mount Chittenden was made. Mr. Hague considers this mountain one of the best points of observation within the limits of the park, and, after a trail has been built to it, thinks it will become one of the objective points of tourists who visit the lake. It surpasses Mount Washburn; as it gives a closer and more detailed view of the lake, and presents a magnificent panorama of the high mountain range on the east side of the park. The prospect is perhaps not so ex-

tensive as that seen from the summit of Mount Sheridan, but it is superior to it from the fact that the objects one wishes to see are nearer at hand. On the eastern slopes of the mountain is a remarkably fine glacial cañon.

From the Yellowstone Falls, camp was moved once more to the geyser basins, whence a trip was made to the western limits of the park, *viâ* the Madison plateau, returning through the Madison cañon, which exposes a fine section of the rhyolitic rocks that form the plateau.

The latter part of September camp was again established at the Mammoth hot-springs. The weather throughout the month had, with the exception of a few days in the latter part, been exceptionally fine for field-work; but October was ushered in with a severe snow-storm. Notwithstanding the inclemency of the weather, Messrs. Iddings and Wright undertook a reconnaissance of the region north of Mount Holmes, on the west side of the park, with a view to obtaining more accurate information as to the granitic area that lies just east of the rhyolitic flows that form the plateau of the park. The results, however, were meagre, on account of the severity of the storms and the depth of the snow.

At the same time Mr. Hague, accompanied by Mr. Weed, crossed the park in the opposite direction, to the head waters of Soda Butte Creek, with two objects in view, — 1°, to make a rapid geological reconnaissance across the northern part of the park to obtain definite personal knowledge of the Yellowstone Range; and, 2°, to visit the Clarke's Fork mines in order to learn their position in relation to the park boundaries, and to ascertain the extent to which mining operations have been pushed, and also to form an opinion as to the future prospects of the district as a mining-centre. The trip was a valuable one for general geologic purposes, and as suggesting plans for future operations, but for detailed work was not perfectly satisfactory, as the country was covered with snow, and snow-storms were of daily occurrence.

Although work was continued for some time longer in the vicinity of the Mammoth hot-springs, the weather remained so stormy that it was decided to pack the collections and leave the field; which was done the latter part of October, when the members of the party returned to the east.

Physical researches. — The geysers of the park suggest a number of physical questions which can be solved only after a complete and careful investigation, opportunities for which are nowhere presented with greater facilities than within the limits of the Yellowstone national park. The study of these questions was assigned to Dr. William Hallock, who steadily carried forward his observations in the Fire Hole geyser basins during August and September, and, since his return from the field, has been conducting a series of experiments in the laboratory at New Haven. When the results of these studies and experiments shall be made public, it will be seen that they are of the utmost scientific value.

Photographic work. — Mr. William H. Jackson, so well known from his photographic work in the park, while connected with Dr. Hayden's survey of the territories, accompanied Mr. Hague's party, and had a most successful season. His series of instantaneous views of the geysers in action will prove of great interest.

He obtained a large view (sixteen by twenty-two inches) of the lower falls of the Yellowstone, from a point at the bottom of the Grand Cañon just below where the water reaches the cañon, after its descent of more than three hundred feet. He also secured a fine large panoramic view from the summit of Mount Washburn.

A number of views of Yellowstone Lake were taken, that are particularly good.

Topographic work. — In order that the detailed geologic structure of the park may be correctly delineated, it was decided to begin topographic work for a detailed map, especially as the survey of the western and north-western portions of the park had never been completed. This work was intrusted to Mr. J. H. Renshawe, who undertook plane-table work on a scale of two inches to the mile. He outfitted his party at Bozeman, Montana, and began work in August in the West Gallatin Range, — a beautiful and interesting group of mountains, seldom or never visited by tourists, lying in the north-west corner of the park, between Gardiner's River and the West Gallatin River. The outlying spurs are cut and worn into most peculiar forms by glacial action. The survey of this area, comprising about four hundred square miles, occupied nearly a month, on account of the rugged character of the country and the detail with which the work was carried on. In the more level portions of the park it progressed more rapidly. Three hundred square miles of the plateau region lying more to the southward were surveyed during the latter part of the month. In September the work was extended still farther to the southward, until the heavy snows early in October compelled the postponement of further work to another season. The entire area surveyed in detail during the season is outlined as follows: on the north and west the limits are the boundaries of the park in those directions; on the east it is bounded approximately by the Norris wagon-road and Gardiner's River; and on the south by the lower geyser basin and the Fire Hole River. Besides the detailed work thus defined, meanders were run, and preliminary work extended, over all the usually travelled routes.

Upon the return of the party to Bozeman in October, a remeasurement, with compensated bars, was made of the base-line at that place, laid out in 1877 by the 'Geographical surveys west of the 100th meridian.' In this work Mr. Renshawe was rendered efficient service by Messrs. Chase and Garrett of the U. S. navy. The former is now at work on the computation and adjustment of these measurements.

Potsdam fauna at Saratoga, N.Y. — Mr. C. D. Walcott is closing up his work on the paleontology of the Eureka district, and preparing to take up the Potsdam fauna of the United States. From the past season's field-work, it was discovered that a massive

limestone, containing a typical Potsdam fauna, overlies the Potsdam sandstone of the New-York geologists in Saratoga county, N.Y. This limestone rests above the sandstone of Keesville, Whitehall, and Corrinth, and is shown to be the true representative of the Potsdam sandstone of Wisconsin, as it contains Lingula accuminata, Platyceras minutissima, Metoptoma cornutiforme, Crepicephalus sp.?, Lonchocephalus calciferous, Dicellocephalus Harti, and Ptychaspis speciosus, — species all closely allied to those from Wisconsin. This limestone was referred to the calciferous formation originally; the great Stromatopora-like bodies of Hoyt's quarry, four miles west of Saratoga, occurring in it.

The contained fauna was partially described by Mr. Walcott in the thirty-second annual report of the New-York state museum of natural history, and referred to the calciferous formation.

The U. S. naval observatory.

Chronometers. — This department of the observatory is in charge of Lieut. E. K. Moore, assisted by Lieuts. E. C. Pendleton and U. R. Harris. There are at present in the chronometer-room 233 chronometers, of which 22 are ready for issue; 21 are on trial; 71 require repairs, and will be repaired as wanted for issue; and 119 are condemned to be used only as 'hacks.' A temperature-room has been constructed for the more perfect testing of chronometers, and the observatory is now prepared to test them at any temperature to which they will be subjected in their practical uses. A proposition was made to the chronometer-makers, each to place four chronometers at the observatory for a competitive trial, beginning Jan. 1, 1884, the bureau of navigation to purchase the four passing the best trials. This has been accepted by William Bond & Son, Boston, T. S. & J. D. Negus, John Bliss & Co., and D. Eggert's Sons, of New York. By this method of purchasing, the best American made chronometers will be obtained.

Transmission of time-signals. — This work is in charge of the officers having the care of the chronometers. The time continues to be sent over the wires of the Western union telegraph company, and time-balls to be dropped at New York and Washington, as stated in last report. This work is all done automatically by direct connection with the observatory clock. The fire-alarm bells continue to be struck, and the time to be given to the horological establishments of the city at six A.M., twelve M., and six P.M.

Nautical instruments. — This work is in charge of Lieut. W. E. Sewell. 121 sextants and octants have been received at the observatory for examination. 46 of this number have been found in good order. There are remaining on hand at the observatory 77 instruments, 10 of which may be made serviceable by repairs: the remainder have serious defects, which will render most of them worthless. The principal of these defects are bent arcs or bent pivots. Another very common defect is want of parallelism in the glasses. Few of the makers seem to have exercised much care in this respect. The sextants and octants made by Stackpole & Brother of New York are superior to all others. The shades of 5 artificial horizons have been tested for parallelism of the glasses; and 3 were found defective, changing the direction of the rays from 1′ to 2′.5. Two standard thermometers, made for the observatory by J. & H. J. Green of New York, have been tested for their freezing and boiling points, and their tubes calibrated. At no point was the error found to be greater than a fifteenth of a degree. Tables of corrections for 45 clinical thermometers have been made for the marine hospital service.

The library. — The library now contains nearly twelve thousand volumes. The accessions for the year aggregate sixteen hundred and two volumes, besides a large number of pamphlets. The annual volume of astronomical and meteorological observations for 1879 has been recently received from the public printer, and the copies are now being sent out. The demand for the volumes is very great, there being six hundred addresses on the regular list. The manuscript, consisting of eight hundred and seventy-five pages, for a complete catalogue of the books and pamphlets in the library, July 1, 1883, alphabetically arranged by authors and subjects, is now ready for printing.

Publications. — The printing of the volume for 1880 is nearly finished, while the manuscript for the volume for 1881 is nearly ready for the printer. The printing of the annual volume is falling behind from year to year; and, with the apparently necessary expenditure of the printing-fund at the disposal of the navy department, this seems inevitable. The department fund is ususally exhausted by the last of April, and then two months' time is lost. If there were a fund at the sole disposal of the observatory, this difficulty could be overcome. The superintendent therefore urges that Congress be asked to appropriate seven thousand dollars annually for printing the observatory volumes, until the back work can be brought up as near as practicable to date.

U. S. astronomical expedition to Chile. — Professor William Harkness, assisted by Mr. Emil Wiessner, has made progress in reducing the zone observations made in Chile during the years 1850, 1851, 1852, by the expedition under the late Capt. J. M. Gilliss, U.S.N. The total number of stars is about seventeen thousand. On June 30, 1883, the appropriation from which Mr. Wiessner was paid became exhausted, and the work ceased. About a thousand dollars are needed to finish the preparation of the star catalogue from these zones, and it is hoped that Congress will grant that sum at the next session.

Increased estimates have been submitted for the coming year. The reasons for such increase are explained in each case in the letter accompanying the estimates. Experience suggests that the efficiency of the observatory should be increased by the appointment of a board of visitors, to consist of a limited number of distinguished astronomers, whose duty it would be annually to examine into the working of the observatory, and report to the secretary of the navy. They should have power to advise with the superintendent as to the character of the work to be done at the observatory.

NOTES AND NEWS.

THE death of Professor Ercolani on Nov. 16, 1883, at Bologna, inflicts a severe loss upon Italy; for he was distinguished both as a *savant* and a patriot. Count Giovanne Battista Ercolani was born in Bologna in 1819, and descended from an ancient patrician family. He was a favorite pupil of Antonio Alessandri, and early devoted himself to comparative anatomy and pathology. During the revolutionary movement, which swept over Europe in 1849, he was an ardent defender of Italian liberty, with the result of becoming an exile. He sought refuge in the near city of Turin, and there was appointed professor, afterwards director, of the veterinary school connected with the university. He remained in Turin until 1863, when he returned to Bologna to accept a similar position in the old university of that city. By his energy and influence, new buildings were erected, the school reorganized and greatly enlarged, and a valuable pathological museum established. For several years he held the position of rector of the university, and for a considerable period was permanent secretary of the Academy of science of the Institute of Bologna. Like Virchow, he was also a patriot. His reputation was not alone that of a teacher and *savant;* but his early career as a defender of popular rights made him a favorite with the citizens, and he was three times elected and served in the national parliament at Rome.

His numerous publications have contained the results of investigations made for the most part with the microscope, and have secured a wide reputation to his name. Most of his contributions first appeared in the memoirs of the Accademia di Bologna. His works show ability both as an observer and a draughtsman, and a tendency to touch upon general problems; but his arguments are not always clear, nor his observations sufficiently complete to establish his general theorems. He was an enthusiastic, careful, and industrious investigator, of whom Italy was justly proud.

His most extensive series of researches was upon the histology of the placenta, which led him to the conclusion that the lining membrane of the uterus degenerates, the placental membrane being a new formation, the lining being reformed afterwards from the uterine glands. This is not in accord with the views generally held at present. His single law of embryonic nutrition in vertebrates can hardly be considered novel, and is vague rather than profound. But the details recorded in these researches are of great value and interest. These memoirs, together with some additions supplied by the author, were translated into English, and published at Boston in 1880, under the direction of an enthusiastic admirer, Dr. H. O. Marcy.

His studies covered a wide range, — zoölogy, histology, and pathology were all included; but his most valuable work lay in the field of microscopical anatomy. His career has been justly admired, and his memory will long be cherished by his countrymen.

— The Government printing-office has just issued the third volume of the report of the tenth census. This relates to agriculture, and contains, besides the extended statistical tables concerning that industry, and discussion of them by the late superintendent, Gen. Walker, monographs upon cereal production, by William H. Brewer; flour-milling, by Knight Neftel; tobacco-culture, by J. B. Killebrew; manufacture and movement of tobacco, by J. R. Dodge; and meat-production, by Clarence Gordon.

Of the 1,182 pages embraced in this volume, 328 are devoted to the general statistical tables. These are exhaustive, and are very judiciously arranged for reference and use. A general summary, by states, of the principal statistics in 1880, 1870, 1860, and 1850, forms the first table. It treats of the number of farms; the area in farms, classifying the land as 'tilled,' 'permanent meadows, pastures,' etc., 'woodland,' and 'other unimproved' land; the value of farms, farming implements, and machinery; of live-stock, fences, fertilizers, and of all farm products; the number of the different classes of live-stock; the dairy products; cereal and fibre crops; sugar and molasses; hay, poultry, and eggs; apiarian products; rice, tobacco, Irish and sweet potatoes; orchard, market-garden, and forest products; wool, hops, broom corn, and pulse. Following this is a tabular discussion of the number and area of farms, and their form of tenure, by states and by counties. After this are placed county tables relating to the principal agricultural products. These tables are preceded by Gen. Walker's discussion (comprising 33 pages), in which are pointed out the limitations and qualifications of the statistics, and our progress in the different branches of the industry. It treats, in the author's well-known terse, incisive manner, upon the number and size of farms, their area and tenure, their value and that of farm products in total, and the principal agricultural productions severally.

The monograph by Professor Brewer upon the cereal crops is, like all work by this well-known authority, complete and exhaustive. He discusses the cereal product of this country as compared with that of other countries, especially with that of Europe; showing, that, with a surplus production in the United States of 650,000,000 bushels during the census year, there was a deficit in Europe of 380,000,000. The deficit in Great Britain was 280,000,000; in France, 170,000,000; and in Germany, 115,000,000 bushels. Following this discussion, the author naturally treats of the exports of cereals, noting their rapid increase in recent years. Their geographic and climatic distribution is next discussed, and is followed by a brief sketch of the principal classes of soils with relation to their applicability to cereal culture. Taking up the cereals severally, Professor Brewer discusses the product of each, its geographical and climatic distribution, its history, varieties, methods of culture, chemical composition, diseases, injurious weeds, and insects. The report closes with a brief history of American agriculture, and a discussion of the relations of this to other industries, and

of cereal culture to other branches of agriculture. The report is illustrated with sixteen double-paged colored charts of the United States; showing the proportional extent of cereal culture, and the relative yield of cereal crops per acre, and per head of population.

The report upon flour-milling processes is one of a series upon power and machinery, which subject was under the general direction of Prof. W. P. Trowbridge of Columbia college, New York. It treats somewhat at length of the various milling processes and machinery, and is freely illustrated with outline plates.

Professor Killebrew's report upon the culture of tobacco occupies not less than 286 pages. Besides the tables of production, and a few pages descriptive of the principal types of tobacco, the report consists of descriptions of soils, climate, methods of culture, curing, and marketing of tobacco. Each state is treated separately and very fully, which necessarily produces a great deal of repetition, and thereby unnecessarily extends the report. The concluding chapter consists of a treatise upon the chemistry of American tobaccos, by Gideon E. Moore, Ph.D.

The manufacture of tobacco is treated by Mr. J. R. Dodge, now and formerly the statistician of the department of agriculture. Commencing with a history of tobacco-production in this country, he traces it up to the present time, sketching the origin and the present habitat of the different varieties. Proceeding then to the subject proper of the report, the author submits the statistics, and discusses them exhaustively. He next takes up the subjects of taxation and the revenue from this product, exports and imports, the commercial movement and prices, with which the report closes.

The report upon cattle, sheep, and swine, by Mr. Clarence Gordon, is supplementary to the statistics upon live-stock. This report relates to live-stock upon ranches as distinguished from that upon farms. The distinction is not an easy one to draw in all cases, the line between ranch and farm being by no means a plain one; and one cannot help questioning the utility of attempting to separate them. The report opens with a short chapter upon pasture and forage plants by Professor Brewer. The report proper follows, each state and territory being treated separately. The matter relating to each consists of an historical sketch, a description of the pasturage areas, and the management of the ranch business, both in cattle and sheep raising and in cattle-driving. The estimates of pasture-land are in most cases undoubtedly very much too great; as, for instance, that four-fifths (50,000,000 acres) of the area of Wyoming is available as pasture-land. The report closes with a summary of the exports of meat and live-stock, and tables of the numbers of live-stock on farms and ranches.

In its outward appearance, this volume, as well as those which have preceded it, is not by any means above criticism. The only part of the mechanical execution of these volumes which deserves commendation is the colored plates, which were presumably printed by the lithographers. It is greatly to be regretted that so important and valuable a series of volumes should not be dressed in a garb in better keeping with their intrinsic merits.

— Dr. R. W. Shufeldt has asked authority of the surgeon-general of the army to compile an illustrated catalogue of the collection of comparative anatomy in the army medical museum, of which he has lately been placed in charge. Such a work as is intended, would be contained in a volume conformable in size with other illustrated catalogues of this institution that refer to the sections of surgery and medicine.

There are contained in the section in question upwards of three thousand specimens. These are chiefly osteological in character; and the classes of mammals, birds, reptiles, and fish, are pretty well represented. The general plan of this catalogue is to make it a complete work of reference to the collection. Each of the genera of all the vertebrate classes are to be awarded an illustration, and the text will present a concise account of the anatomy of the form treated. In every instance where it will be possible, the subject, be it an osteological one or a wet preparation of the soft parts, is to be chosen from the museum collection; so that any person using this catalogue will have the actual type before him, and the one that was selected to illustrate the text. Special attention is to be paid to the anatomy of such vertebrates as elucidate the principal questions in human physiology and anatomy, and good figures and illustrations of such forms will invariably be presented. Again: the vertebrates of our own country will be the subjects chosen in each case, as far as possible. By this means the student and anatomist may pursue his studies away from the museum after he has investigated all that is to be found there in his special line of research, and that, too, upon similar subjects. In short, it is evident that such a work will constitute a more or less exhaustive contribution to the literature of vertebrate anatomy, and be of special value to all scientific and professional men. The army medical museum contains within itself unusual facilities for the prosecution of such a work at comparatively little expense; since it has its own corps of workers, including photographer, artist, and others.

— Mr. Joseph Wharton of Philadelphia writes to the *Public ledger* of that city (Jan. 22) that he has found volcanic glassy dust in fresh, clean snow of recent fall. The snow, melted under cover in the porcelain vessel it was gathered in, showed at first no sediment; but after a time, and aided by a gentle rotatory movement which brought all to the deepest point, a slight deposit appeared. By pouring off most of the water, and evaporating the remainder, a little dry dust was obtained, which, even to the naked eye, showed, in the sunlight, tiny vitreous reflections. The dust weighed by estimate a hundredth of a grain, and showed under the microscope the characteristics of volcanic glass. It was partly irregular, flat, and blobby fragments, and partly filaments more or less contorted, which were sometimes attached in little wisps, and were mostly sprinkled with minute glass particles. Under a knife-edge, the filaments broke easily and cleanly. The irregular

fragments were of various sizes and shapes, mostly transparent, but, even when examined by strong transmitted light, showed no trace of crystalline structure. Their diameter was about that of single filaments of silk. No crystalline particle of pyroxine, or black crumb of augite, such as observers have found elsewhere in similar dust, was present; nor did a strong magnet stir any particles of magnetic oxide of iron, though they also have been found in other volcanic dust. It may fairly be assumed that those heavier minerals, if at first mingled with the volcanic glass, had been already deposited during the long voyage through more than ten thousand miles of space and more than four months of time, while the tenuity of the intrinsically lighter glass threads (the Pele's hair of Mauna Loa) enabled them to float farther from the point of eruption.

— The maps recently published by the Northern transcontinental survey, the discontinuance of which we regret, include the Crazy Mountains and Judith Basin in Montana, and the Yakima and Colville regions in Washington Territory, — a total area of about twenty thousand square miles, on a scale of two miles to an inch, with contours every two hundred feet. One has only to look at the best previous compilations of these districts to see the need and superiority of the new work. With this excellent basis, Prof. E. W. Hilgard of the University of California, in charge of studies of soils, has prepared three maps, four miles to an inch, printed in colors, of the Yakima and Colville districts, showing the characteristics and possibilities of the surface in much detail. Mr. T. S. Brandegee, working under the direction of Prof. C. S. Sargent of Harvard university, in charge of forestry, has also completed a map of the Yakima district, showing the distribution of the valuable trees in much detail: a regretably large area is marked as burnt.

These maps form but a small share of the material now collected: the greater part is not yet prepared for publication. In Mr. Pumpelly's first annual report, mention is made of the discovery, by Mr. George H. Eldridge, of valuable coal close to the line of the Northern Pacific railroad, near Bozeman, Montana; and of explorations of the coal-fields west of the Cascade Range by Mr. Bailey Willis. Studies of climate and rivers were undertaken by Prof. E. S. Holden of the Washburn observatory, — studies of the utmost importance in the interior region, where cultivation, unless on the lowest bottom-lands, is impossible without irrigation in the drier summer months. Much material has been brought together by Mr. W. M. Canby concerning the distribution and relative abundance of the various forage-plants on which the stock-raising interests depend. It is sincerely to be hoped that the results of these practical studies may be brought to light, together with the scientific information gathered during the two seasons during which the survey has been in operation.

— *Nature* reports that the French Société des électriciens has completed its organization, and has been divided into six sections, — Theoretical electricity, M. Marie Davy, president; Dynamo-electrical machinery, transmission of force to a distance, distribution of energy, M. Tresca, president; Electric lighting, M. du Moncel, president; Telegraphy and telephony, M. Blavier, president; Electro-chemistry and electrotherapy, M. Jamin, president.

— At the last general meeting of the Société de géographie, M. de Lesseps announced his conclusions on the subject of the Suez Canal. A project had been submitted to the English government; and, if a favorable response be not received, the canal company will proceed to carry out its own plans. He claimed that no one else had a right to make a canal by the side of the present one, and that this occupies the only feasable route. To the west the topography presents obstacles. To the east, a new canal would destroy the system of irrigation upon which the wealth of the country depends. All that is needed is to enlarge the present canal. When this was projected, the most eminent engineers of all countries decided on a canal with forty-four metres width at its maximum depth; but, owing to great expense and opposition encountered, the company contented themselves with a width in this part of twenty-two metres, which completely satisfied the needs of the commercial world of that day. Twenty-five years ago the increase of steam-navigation was not dreamed of. In 1830, of five hundred vessels composing the expedition to Algeria in the port of Toulon, there was not one steamer. In 1882 seven millions of steam tonnage passed through the canal, and only one sailing-vessel of seventy-five tons. The principal question to be determined at present, is, whether the enlarged canal shall consist of two waterways with an embankment between them, or whether the breadth of the present waterway should be extended to forty-four metres at the bottom and a hundred and twenty at the surface of the water. This would be decided by the engineers consulted, though the speaker was in favor of the latter plan, as swift vessels could then pass slow ones. The embankments of the canal are a relic of the days when vessels were towed. He saw no reason why the enlarged canal should have any embankments purposely constructed. The dredgings, which will be much less considerable than in the original work, can be dumped by the side of the canal, and thence spread out without maintaining a bank of any kind. This, at least, was M. de Lesseps's opinion.

— Prof. F. H. Snow, of the University of Kansas, reports that the chief characteristics of the weather of 1883, from observations taken at Lawrence, were the low mean temperature of all its months except April, November, and December; the unusually long period of immunity from severe frost; the large and well distributed rainfall; the slight preponderance of northerly over southerly winds; the high average wind velocity; the very high mean barometer, surpassing that of any previous year of our sixteen years' record; and the remarkably brilliant and long-continued orange and crimson sunrise and sunset glow of the last five weeks of the year.

SCIENCE.

FRIDAY, FEBRUARY 8, 1884.

COMMENT AND CRITICISM.

THE modern revolution in biology has made it plainer than ever before, that a certain elasticity of scope, a power of adaptation, should belong to scientific foundations. These are usually the outgrowth of enthusiasm, which, at a white heat, is not always so tempered with wisdom as to foresee that the special end then to be met may not forever be of paramount importance. It must be some such explanation as this, which is to be given of the state of affairs recently described by Dr. Harrison Allen of the University of Pennsylvania, as existing in Philadelphia. In the *American* of Jan. 26, Dr. Allen asserts that the existing foundations of Philadelphia are unequal to the present emergencies of biological science, and urges with much force that "an institution for the advancement of biological research, which will be open to both sexes, is imperatively demanded" in that city.

With the widening of the field of biological science, it has come to pass that what we need most at the present time is a new order of things. Academies and museums we must always have; and fortunately, in these respects, we already equal our transatlantic brethren. But that these alone do not cover all of the ground, is evident from the following remarks of Dr. Allen, concerning the Academy of natural sciences in Philadelphia: "The institution is committed to the task of accumulating a reference-library and a museum, of publishing proceedings and occasional memoirs, and affording a reading-room to any and all who are in the remotest degree interested in natural history, and, to this end, to give rudimental instruction at stated intervals to miscellaneous gatherings." All this is well, except that it 'is committed' to this line of work; and even this would be highly satisfactory, if it were not 'committed' to this alone, as appears to be the case: for the author continues, "The representative members of the academy have acknowledged that the higher education is not within the scope of its work, and have uniformly opposed any attempts at so changing the policy of the society as to admit of any responsibility being unreservedly assumed by its scientific men." That this view should be entertained by the members of organizations instituted long ago, and now endowed with a host of venerable traditions, is, of course, natural; but it is perfectly plain that these alone are no longer sufficient.

Dr. Allen would supply the deficiency which he laments by another foundation, — a biological institute, free from restrictions, liberally endowed, and headed by some one of high repute, qualified especially to inspire and to direct research. We see no reason why a plan like that proposed should not be an immediate and pronounced success, especially in Philadelphia, where science has long been at home, and which is so fortunate as to possess in Professor Leidy an enthusiastic leader and investigator eminently qualified to be the head and front of the new enterprise. We should rejoice to see some such enterprise begun in Philadelphia, particularly if it might enable advanced workers to take immediate advantage of that rich field for zoölogical research in our country which is the admiration and envy of European zoölogists. To this end the endowment should be ample, — we believe, considerably larger than the one hundred thousand dollars suggested by Dr. Allen. It should be, at the least, sufficient to enable advanced workers to proceed to points of timely and special interest; as, for instance, to the Great Lakes, or to the shores of the Gulf, — not to establish laboratories, but to pursue certain lines of research which imperatively require the presence

of the investigator in the field. It is certain that such an enterprise would arouse enthusiasm at home, and command respect abroad.

Mr. B. J. Lossing has recently published a paper on the proposed celebration, eight years hence, of the four hundredth anniversary of the discovery of America. We refer to it now, not to discuss this project, but to call attention to an historical question of such interest that it is worth a thorough investigation. Among mistakes which might almost be classed as popular superstitions must be placed the wide-spread notion that the rotundity of the earth was nearly unknown until comparatively recent times. Mr. Lossing goes so far as to say that the scholars in the time of Columbus ridiculed the idea of the earth being globular, and in this he only echoes the popular belief on the subject. Now, the fact is, that the form of the earth has been as well known as it is now from the earliest historic times, and has never been denied by a scientific writer on scientific grounds. Through twenty centuries of discussion among rival systems and theories, this one has stood undisputed as the fundamental fact of astronomy. Nor has it ever been the subject of religious controversy, as the Copernican theory was. Under these circumstances, it is a question of interest, whether a state of things of which the astronomers never heard existed in Spain four centuries ago; whether, in fact, there are books or documents of any kind showing that men who then ranked as scholars believed the earth's surface to be flat. We suggest the subject to historical investigators.

It must, of course, be understood that we are now speaking of professed scholars, in a position to be consulted by the authorities, and not of the ignorant masses. It is quite likely that Queen Isabella's chambermaid may have ridiculed the idea of the earth being round, and that her spiritual confessor may have looked upon astronomical theories generally as the work of men very dangerous to orthodox religion. But if the knowledge of an epoch is that of the majority, where shall we stop? It might be found, that, at the present day, the majority of the human race believes the earth to be flat. We leave our readers to picture in their minds an encyclopedia of the thirtieth century, in which it will be stated, that although the astronomers of the nineteenth century knew of the motion of the earth, yet their more numerous and influential contemporaries, the theologians, as represented by one of their leaders named Brother Jasper, believed it to be at rest.

The acquittal of General Cesnola of the charge of libel, in the case so long before the courts, is probably satisfactory to the trustees of the Metropolitan museum of art, but is far from satisfactory from a scientific stand-point. So far as the trial related to libel, it made no difference to science which side won; but it does make a difference when it appears, that, by legal twists and turns, the vital spot was not touched. As the result stands before the scientific world to-day, the curator, while acquitted of the charge of libel in his hot reply to a former business agent, is still, directly or indirectly, responsible for the manipulations of ancient sculptures in the museum under his charge. One good result may follow from the Cesnola trial. In future, fragmentary objects in museums will probably either be left as found, or else so joined, that, while holding their relative positions, they will still show that they are fragments. The so-called restorations are too often the conceptions of the officers in charge; and, while Cesnola has followed a plan often sanctioned by supposed requirements of art, it is one which will never be permitted by science.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Tropical cyclones.

In Mr. Davis's paper on whirlwinds, cyclones, etc., in *Science*, vol. ii. pp. 758–761, I notice the use of the term 'equatorial cyclone,' which should be discontinued, as I have already had occasion to state before.[1] There being no deflection of the winds from the normal to the isobars on the equator, there can be no cyclone there; and it is, I think, generally ad-

[1] *Nature*, vol. xix. p. 517.

mitted by meteorologists, that in the latitudes 0°–6° the deflection is also too small to admit of cyclones; and really I know of none. And even outside India, and the seas around it, there are scarcely cyclones in latitudes lower than 10°.

Thus, what Mr. Davis calls 'equatorial' should be called 'tropical' cyclones. If anybody wishes to mention 'equatorial cyclones,' let him first prove their existence. So long as this is not done, meteorologists having a mind for exact scientific terms will hold to my opinion. A. WOEIKOF.

St. Petersburg, Jan. 7, 1884.

I shall be well pleased if so distinguished a meteorologist as Dr. Woeikof finds no other points needing correction in my papers on storms than this one. That I fully agree, as to the facts, with him and with Dr. Taylor, who first, so far as I know, states this matter in connection with its cause,[1] is shown in my seventh paper (this volume, p. 40); but, while my use of the objectionable term was accidental rather than deliberate, there is, perhaps, little to choose between 'equatorial' and 'tropical,' both of which occur in this connection in my papers: for, if the first apply in strictness only to points in latitude 0°, the second is equally limited in its exact meaning to points in latitude 23½°; and if 'tropical' has come to mean 'within or between the tropics,' so 'equatorial' may mean 'near the equator.' *Tropenzone* of the Germans is not to be translated 'tropical zone,' but 'torrid zone;' and in English, 'tropical' should not be applied in an exact nomenclature to the equatorial low pressures of the doldrums, as in Buchan's writings, but rather to the high pressures of the horse-latitudes, as Ferrel uses it; and 'tropics,' when properly rendered into German, would be *wendekreisen*, or it might be paraphrased into *die polargrenzen der passate*. Inasmuch, then, as the truly tropical belts of the ocean are best characterized by regions of high pressure, free from cyclonic conditions, except where storms from lower latitudes cross them near their western shores; and as the *inter*-tropical rains of the doldrums are not called 'tropical,' but 'equatorial,' even when off of the equator, and by Dr. Woeikof himself, — it can hardly be considered a serious error to speak of the cyclones, which begin in the doldrums, as equatorial also.

Cambridge, Jan. 30, 1884. W. M. DAVIS.

Osteology of the cormorant.

Mr. Jeffries' answer in *Science* (iii. 59), to my letter in a former number of this paper (ii. 822), caused me genuine surprise. His suggestion that the occipital style of the cormorant 'is the ossified tendon of some of the extensor muscles of the neck,' made in a former communication (ii. 739), is here, apparently, announced as his conviction, and Selenka is introduced to sustain the statement. Now, I am informed by Mr. Jeffries, that, "in view of such eminent authority, it would seem that something more than simple denial is required to upset a statement accepted by anatomists for many years;" and a few lines farther on, I am said to acknowledge my mistake, because I ignored the point. Permit me to say, that nothing of the kind has been accepted by anatomists for many years. I met this statement by a simple denial, in order to save space in the columns of *Science;* but, if Mr. Jeffries must be informed as to what the occipital style of the cormorant is, I would inform him that this bone is not an ossification in any tendon of the extensors of the neck, because it is situated, as we know, in the median plane of the skeleton, at a mid-point on the occipital ridge. The tendons of the extensors in a bird's neck, which are inserted at the occiput, are in pairs, their insertion being bilateral; and their tendons are *never* inserted in the median plane: consequently this style cannot be an ossification of any of them. On the contrary, *it is* an ossification of the fascia between the extensors of the neck and what may be compared to the ligamentum nuchae.

As Mr. Jeffries seems to be anxious about the position in which I drew this occipital style, I would call his attention to the fact that it is shown as occupying its *proper site*, only tipped up somewhat, as it was on my dried skull. Such license is perfectly permissible in anatomical delineation, and is seen in the illustrations throughout the literature of anatomy. It often shows the parts to better advantage; and, in structures as well known as this style is, no explanation is necessary. Acquainted, as I am, with the *anatomy* of this 'nuchal style' and its anatomical relations, I must again acknowledge that I am still ignorant of the *physiology*, or really the function, of this style, or why it should occur in a cormorant and not in other birds nearly related.

As to Mr. Jeffries' concern at my not being, to his mind, thoroughly informed upon the homologies of the patella in birds, I would invite his attention to a paper of mine written some time before my 'Osteology of the cormorant' appeared. To show that I have always agreed with the eminent authorities he alludes to for my benefit, in the co-existence of a patella and an elongated cnemial process of the tibia in most divers, I refer to my article entitled 'The number of bones at present known in the pectoral and pelvic limbs of birds,' in which I say, "I know of but two free bones that occur about the knee-joint. The first of these is the patella; and this may co-exist with the cnemial ridge of tibia, as in Colymbus (Owen). The other is a free sesamoid found in some birds in a notch at the head of the fibula (Speotyto)" (*Amer. nat.*, November, 1882, 894). I repeat, that 'I find myself misquoted' by Mr. Jeffries, in his remarks upon my paper, 'more than once;' that is to say, he has failed to include statements falsely attributed to my article in the customary quotation-marks. I do not say, (1) that I figure this style '*in situ*,' nor (2) positively affirm that it has never been figured before (ii. 739), but do say, "I do not believe we have a figure showing the site of this bonelet" (ii. 640). Selenka's and Eyton's figures had slipped my mind for the moment, as their works had not been available for a year or more. Furthermore (3), I do not refer to Professor Owen to have him authorize any thing in regard to Podiceps, but only to the patella of the loon, as any one accustomed to anatomical reading can see by referring to my article on the 'Osteology of the cormorant' (ii. 640).

R. W. SHUFELDT.

Upperglow of the skies in relation to halos and coronas.

These striking and beautiful atmospheric phenomena, which have manifested themselves over the entire globe, have attracted much attention, and been minutely described by correspondents in various countries. But there is one feature, which, although incidentally noticed by some writers, has attracted but little attention. I allude to the fact, that, wherever

[1] On tropical hurricanes (Brit. assoc. report, 1852, pt. 2, 31). Herschel used this in his Meteorology, but failed to do justice to Taylor's explanation of how a deflective force arises from the earth's rotation, and omits mention of the effect of the conservation of areas, which Taylor recognizes as of essential importance.

the phenomena have been sufficiently pronounced, the sun is during the day encircled by a more or less distinct *colored halo or corona.* At this place the assumed supra-cirrus volcanic dust seems not to have been sufficiently dense to have developed the colored rings; and there was observed nothing more than a *whitish glare* extending over the sky from 20° to 25° from the centre of the sun. But the Rev. S. E. Bishop writes me from Honolulu, that this chromatic circle around the sun has been constantly observed in all of the Hawaiian Islands for several months. It has likewise been observed in England as a frequent accompaniment of a conspicuous manifestation of the upperglows of sunset and sunrise.

It is an interesting question, whether this more or less distinct colored zone encircling the sun is a true *ice-crystal halo*, or a *diffraction corona.* Its want of sharp definition, and the absence of the regular succession of prismatic tints due to refractive dispersion, would seem to point to diffraction as the true cause of the chromatic phenomena. On the other hand, the large size of the colored circle, having a radius of from 20° to 30°, would seem to connect it with the well-known ice-crystal halo of about 22° radius.

While I am disposed to regard this chromatic feature of the phenomena as mainly due to the diffractive action on light of the impalpable dust-particles suspended in the lofty supra-cirri regions of the atmosphere, yet it is by no means improbable that ice may be associated with the phenomena: for it appears from the experiments of M. Coulier, and more particularly from those of Mr. John Aitken, communicated to the Royal society of Edinburgh, Dec. 20, 1880 (*Nature*, vol. xxiii. pp. 195–197; also vol. xxiii. p. 384), that the presence of dust-particles in the air is essential to the formation of fogs and clouds; that, when aqueous vapor condenses in the atmosphere, it always does so on some solid nucleus; and that the dust-particles in the air form these nuclei. Now, it is evident that the presence of these attenuated dust-particles in the supra-cirri regions of the atmosphere would produce condensation of the rarefied aqueous vapor at these lofty altitudes. But inasmuch as this region must, even within the tropics, be far above the plane of perpetual congelation, the condensed vapor must necessarily assume the form of aggregations of ice around these nuclei: hence the diffractive coronas may be associated with imperfectly developed ice-crystal halos. JOHN LECONTE.

Berkeley, Cal., Jan. 25, 1884.

Inheritance of physical injuries.

Well-authenticated instances of the inheritance of a physical injury are so rare, that I wish to put upon record one which has recently fallen under my observation. A gentleman, when a boy about seven years of age, had the second toe of the right foot deformed by wearing a tight boot. The first and third toes were crowded together, forcing the second one under and backwards, and causing a curvature of the second joint, which, in time, became permanent. The joint, being somewhat elevated above those of the other toes, received the pressure of the shoe, and always after was more or less troublesome in consequence. The gentleman was twice married. By his first wife he had six children, the second of which was a daughter; the rest, sons. The daughter inherited the crooked toe; but the feet of all the sons were normal. The deformity appeared, however, in the son of one of these, — the brother next younger than the sister, — affecting the same foot and toe as on the grandfather. By his second wife the gentleman had only one child, a son, who also inherited the peculiarity; but in this instance it was the second toe of the *left* foot, instead of the right, that was affected.

Knowing that much doubt still exists whether the results of a slight physical injury, like the one I have described, are ever transmitted, I have taken pains to examine carefully all the evidence under my observation; and I feel assured of its correctness. All four having the deformed toes are now living, and all agree upon the facts. The gentleman is positive that his feet were normal until he was about seven years old, and says he remembers very distinctly wearing the boots which caused the deformity. An examination of the foot does not show any congenital peculiarity which might have been transmitted. The toe, when restored to its correct position, appeared normal in every way. No peculiarity of this kind has ever appeared in any other of the gentleman's relatives. I can see no way, then, of avoiding the conclusion that the injury, or rather its results, have been transmitted to two generations.

The case presents some features which render it especially interesting. The peculiarity's appearance in the children of both wives seems to eliminate altogether the element of the mother's influence in producing it. The recurrence of the variation in the grandchild, the father being normal, indicates how powerful was the tendency to perpetuate this slight deviation from nature's standard. In the other cases which I have studied personally, if a variation did not appear in a child, that child's children were free from it also. I should be glad to know if any one of your readers has observed this tendency toward reverting to the ancestral type under similar circumstances. IRVING P. BISHOP.

Perry, N.Y., Jan. 28, 1884.

Pumice from Krakatoa.

Capt. A. W. Newell, of the bark Amy Turner of Boston, has brought in some pumice which was washed aboard his vessel, Sept. 17, 1883, in latitude 7° 25′ south, longitude 103° 21′ east, about a hundred and sixty-five miles south-west from Krakatoa, Sunda Straits. It covered the sea in windrows, and was observed as fine ashes as far distant as thirteen hundred and fifty miles from its source.

A piece about seven inches by five, which came to my notice, is of a reddish-gray color, and very much inflated: it carries porphyritic crystals of plagioclase felspar, in many cases surrounded by dark-brown glass, forming small black spots in the gray mass, which might at first sight be mistaken for augite or hypersthene. There is, besides, dark-green augite and brown hypersthene, which is strongly pleochroic, and resembles closely that found in the lavas from the volcanoes of northern California and the Cascade Range (Notes on the volcanoes of northern California, Oregon, and Washington Territory, *Amer. journ. sc.*, September, 1883).

The percentage of silica for this pumice was found to be 62.53, and is almost identical with that of the hypersthene-bearing pumice from Mount Shasta, which is 62. It is undoubtedly the pumice of a hypersthene andesite, and is especially interesting because of its similarity to rocks found on the western coast of North America. The observations of Rénard on the ashes that fell in Batavia soon after the eruption of Krakatoa (*Nature*, Dec. 6, 1883) show the same component minerals, and have doubtless been made on similar material.

JOS. P. IDDINGS.

U.S. geological survey, New York,
Jan. 30, 1884.

THE EVOLUTION OF THE CEPHALOPODA.[1] — II.

THE individual coiled shell of every existing Nautilus may be said to pass through the stages of the protoconch, when it is always nearly or quite straight; then through the first of the conch, when it becomes slightly curved; then through a more completely curved period, in which the first whorl of the spiral is completed. After this it continues the spiral, the whorls on the outside touching the exterior of the inner ones, and spreading so rapidly by growth as to begin to envelop them, and, in extreme cases, to completely cover them up.

The natural inference from these facts would be, that there was a similar succession of forms in past times, — the straight in the most remote, the arcuate and the gyroceran in succeeding periods, and the nautilian only in comparatively modern times. This would be a perfectly clear and legitimate mental conception. The structural relations of the adult shells appeared also to demand the same solution, as shown by the researches of Quenstedt, Bronn, and Barrande, and later of Gaudry. Barrande's researches also demonstrated that this idea could not be maintained, and that there were no such serial relations in time, but that the whole series of forms were present in the earliest period, and occurred side by side in each paleozoic formation. This great author's conclusions have had a curious effect upon paleontologists. It has been hastily assumed by some, that the mental conception was more perfect than could be realized in nature; by others, that the imperfection of the recorded succession was an obvious refutation of the doctrine of evolution, and all pursuit of a solution unworthy of serious attention.

Statistically, the logical picture coincides with the observed succession in time. The straight cones predominate in the Silurian and earlier periods; while the loosely coiled are much less numerous, and the close coiled and involute, though present, are extremely rare. The loosely coiled and close coiled gain in numbers in the carboniferous, and the involute are more numerous than in the Silurian; while, in the later times of the Jura, all disappear except the close coiled and the involute, there being a decided predominance of involute shells. Thus we are able, by reversing the record and travelling back to the Silurian, again to see, that antecedent to that period, in the protozoic, there must have been a time when the straight cones or their immediate ancestors predominated, to the exclusion of the coiled and perhaps even of the arcuate types or varieties.

The involute shells of the earliest geological times were therefore probably evolved from the straight cones in regular succession; and we may perhaps hope to eventually get the evidence of this succession in the formations. The exact counterpart of our logical picture, as Barrande[1] has truly stated, does not, however, exist in the known geological records of later periods. Judged by the common classification, by the prevalent ideas about the affinities of adult structures, and by the modes of occurrence of fossils in the geological formations, the forms seem to be without law or order in their succession.

But let us imagine, during the paleozoic, a different condition of affairs from what is now the general rule. Let us suppose such a thing possible as the quick evolution of forms and structure, and that in these ancient periods, near their points of origin, animals found the earth comparatively unoccupied, and were not only able, but in fact forced, to migrate in every direction into different habitats, and to make perpetual efforts to readjust their inherited structures to the new requirements demanded by these comparatively unoccupied fields. Food and opportunity would have acted, in such localities, as stimulants to new efforts for the attainment of more perfect adaptation and for changes of structure useful to that end. We can neither imagine the effort to change of habitat and habits, without its cause, the primary physical stimulant, nor the change of structure, except as a result of the direct effort to meet the physical requirements with corresponding or suitable structures.

Let us also compare the changes taking place during the whole of paleozoic time with those known to have occurred in certain isolated cases in more recent times; such, for example, as that of Steinheim, where a single species, finding itself in an unoccupied field, proceeded with unexampled rapidity to fill its requirements by the evolution of new series and many species, all differing from each other, but all referable, by intermediate varieties, to the original form, — in this example, really a single species, the well-known Planorbis aequiumbilicatus.

[1] Concluded from No. 52.

[1] We regret that space does not permit some account of th author's wonderful book, the Système silurien de la Bohême. While opposed to almost every theoretical conclusion and the general arrangement of the facts made by him, we have the strongest feelings of respect and admiration for his powers of observation, the technique of his work and publications, and the surpassing unselfishness of his life, spent in the pursuit of what he deems to be vital truths (see *Science*, Nos. 43, 44)

If we admit such possibilities, and then find similar phenomena in the paleozoic epoch, we shall no longer need our first picture, but can construct a far more natural one.

The Nautiloidea will not then present themselves as a simple chain of being, but as they really were, — several distinct stocks, or grand series, and each of these grand series divisible into many smaller lines of genetically connected forms. In the Cambrian, or perhaps earlier, some of these do not have close-coiled forms at all; some of them have: but all, except the most primitive series, which are composed wholly of straight or arcuate forms, have some close-coiled species. These we can often trace directly with the greatest exactness, both by their development and by the gradations of the adult forms, to corresponding species among the straight Orthoceratites.

The series we have described above, from Orthoceras to Goniatites, compares closely with any single genetic series of the Nautiloidea, and shows that this ordinal type arose very suddenly in the protozoic, and evolved true nautilian shells in the Cambrian or earlier.

The Ammonoidea evolved from the nautilian forms of the Cambrian into series, which are structurally much more distinct from each other in the paleozoic than any groups of the same value (i.e., genera) in the succeeding formations, and thus, in different but equally plain characters, teach us that they also had a quicker evolution within that period itself than in the later formations. Either this was the case, or else the Ammonoidea must have been created in full possession of an organization only attained by similar parallel series of congeneric, close-coiled nautiloids, after passing through all the intermediate transformations above described. Here is a curious fact: though taxonomically equal, we cannot compare the order of the Ammonoidea with the whole of the Nautiloidea, but only with a more or less perfect single series of that order. This phenomenon fully accords with the true picture of the genetic relations. The remarkably sudden appearance and fully developed structures of these earlier ammonoids finely illustrates the fan-like character of the evolution of forms from chronological centres of distribution, and the quickness with which they must have spread and filled up the unoccupied habitats.

After the paleozoic, no absolutely new structural modifications are produced; though the complication of the structures is carried so much farther that we are at first apt to imagine that there are several new types of structure in the trias and Jura. We can carry out this assertion, even into some minute structural characters. Thus the mesozoic ammonoids have, in all forms, a curious little short collar, which arises from the septa, and surrounds the siphon. It seems to be useful simply to close the joint, and perhaps make the connections of this tube more perfect, and exists in no nautiloid at present known. It was supposed from its development, etc., to be confined to the Ammonoidea of periods later than the paleozoic, but has recently been noted by Beyrich in a Goniatites of the carboniferous. We have found in a similar way every distinctive structural peculiarity of the mesozoic Ammonites appearing in some form among the Goniatites of the carboniferous.

The contemplation of the wonderful phenomena presented by these series has finally led the author, not without reluctance, to the conclusion that the phenomena of evolution in the paleozoic were distinct from those of later periods, having taken place with a rapidity paralleled only in later times in unoccupied fields, like Steinheim.[1]

The hypothesis of Wagner, that an unoccupied field is essential for the evolution of new forms, gains immensely in importance, if, as we suppose, it is practical to apply it to the explanation of the phenomena we have observed. Every naturalist must see at once, by his own special studies, that this is the only reasonable explanation of the frequent rapid development of types in new formations, as well as the sudden appearance of so many of the different types of invertebrates in the paleozoic. Newberry's theory of cycles of sedimentation shows that the sudden appearance of types is inexplicable, except upon the supposition that they retired with the sea between each period of deposit, and again returned after long intervals of absence, or perhaps made their appearance for the first time in a given fauna.

With this explanation and that of Wagner the facts we have observed fully coincide, and, we think, amply explain the phenomena, both of sudden appearance in the first deposits of formations, and subsequent quick development in the necessarily unoccupied habitats. The researches of Barrande, Alexander Agassiz, Bigsby, Gaudry, and many others, show us that this must have been especially true of the paleozoic or of the protozoic, if this supposed period is admitted, as compared with subsequent periods.

We find, then, that, in order to make our

[1] Another statement of these facts in the form of a law of evolution is given in the author's 'Genera of fossil cephalopods' (*Proc. Bost. soc. nat. hist.*, xxii. 1884).

logical and generalized picture of exact correspondence between all the changes in the life of a nautilian close-coiled shell and the life of its own group accord with the facts, we must be careful to limit it to groups quickly evolved, and these exclusively paleozoic.

In 1843 Auguste Quenstedt began researches which ought long ago to have led to this solution. He demonstrated by repeated examples, that among diseased types the most extensive changes of form and structure might take place in a single species, and within the narrowest limits of time and surface-distribution. Quenstedt was thus the first to show that in diseased forms the shell had the inherent habit of reversing the process of growth and evolution, and of becoming more and more uncoiled by successive retrograde steps. Von Buch and Quenstedt, master and disciple, and the author independently of either of these predecessors, in three successive researches, have arrived at the identical conclusion, that these uncoiled shells are truly distorted, or, as we may more accurately express it, pathological forms. They are not, however, rare or exceptional, as one might at first suppose, but occur in numbers and in every grade, — from those that differ but little from the normal forms, to those that differ greatly; from those that are exceedingly confined in distribution, to those which lived through greater lengths of time. But in all cases they exhibit degradation, and are expiring types. The author has repeatedly traced series of them, and studied their young, partly in Quenstedt's own collection. In all cases they show us that great changes of form and structure may take place suddenly; and this lesson could have been learned from Quenstedt's work and example as well forty years since as now: and in all species the young are close-coiled, even in some which are arcuate in the later larval, adolescent, and adult stages. Baculites, the extreme form, is straight, and the young still unknown.

When we attempt to resolve these pathological uncoiled series and forms, which show by their close-coiled young that they were descended from close-coiled shells, we find ourselves without comparisons or standards in the early life of the individual. The laws of geratology — that the old age of the individual shows degradation in the same direction as, and with similar changes to, those which take place in successive species or groups of any affiliated pathological series of uncoiled and degraded forms — here come into use, and serve to explain the phenomena. This correspondence is shown in the uncoiling of the whorls, loss of size, the succession in which the ornaments and parts are resorbed or lost, the approximations of the septa, and position of the siphon. It is quite true, as first stated by Quenstedt and also by D'Orbigny, that every shell, when outgrown, shows its approaching death in the close approximation of the last sutures, the smoothness of the shell, the decrease in size, etc.; but, in order to realize that these transformations mean the same thing as those which take place in any series of truly pathological forms, we have to return to the types in which unfavorable surroundings have produced distortions or effects akin to what physicians would term pathological. This frequently happens in small series of Nautiloidea; and, if we confine ourselves to these, we can make very accurate comparisons: or, on the other hand, in the case of the Ammonoidea, we may trace the death of an entire order, and show that it takes place in accordance with the laws of geratology. Such series, among the Nautiloidea, are abundant in the earlier formations; but they have not the general significance of the similar forms among the Ammonoidea, and can be neglected in this article. There are no known cases of degraded series of uncoiled forms among the ammonoids of the earlier or paleozoic periods: they may have occurred, but they must have been excessively rare. In the trias and early Jura, pathological uncoiled forms are rare among ammonoids, but in the middle and upper Jura they increase largely; and finally, in the upper cretaceous they outnumber the normal involute shells, and the whole order ceases to exist. Neumayer has shown, that a similar degradation occurs in all of the normal ammonoids of the cretaceous, and that their sutures are less complicated than those of their immediate ancestors in the Jura. This proves conclusively, that the degradation was general, and affected all forms of Ammonoidea at this time; since the uncoiled forms are not confined to special localities, as in the Jura, but are found in all faunas so far as known. The facts show that some general physical cause acted simultaneously, or nearly so, over the whole of the known area of the world during the cretaceous period, and produced precisely similar effects upon the whole type as had here and there been noticeable only within limited localities and upon single species or small numbers of species during the previous periods. This general cause, whatever it may have been, acted on the type so as to cause the successive generations of the larger part of the shells to become distorted

smaller and more cylindrical in their whorls, smoother, and to lose their complicated foliated sutures. In extreme cases they became again perfectly straight cones, like the orthoceratitic radicals. So much alike are they, that it is quite common for those who are not students of this group to mistake the degraded Baculites for the radical Orthoceras. This decrease in size, increasing smoothness, and uncoiling, is precisely parallel with the similar transformations taking place during old age in the normal involute shells of the Jura, which, when old enough, also depart from the spiral, or tend to straighten out, and always lose their ornaments, decrease in size, and so on.[1]

The universal action of the surroundings, as we now know them, is certainly not exclusively favorable to the continuance of life, and may be wholly more or less unfavorable. It certainly perpetually excites the animal to new and more powerful exertions, and, like perpetual friction, wears out its structures by the efforts which it obliges it to make for the support of the structures in doing work. At first this leads to development, the supply being greater than the demand; but sooner or later, and with unvarying certainty, the demand exceeds the powers of supply, and old age sets in, either prematurely, or at the termination of the usual developmental periods. The remarkable and at present unique example of the Ammonoidea places us in a position where we can see the same process taking place in the whole of a large group, with attendant phenomena similar in every respect to those which we have observed in individual shells of the same order.

In numbers of species and genera, and in the complication of the internal structures and the production of the external ornaments on the shells, the order reaches what appears to be the highest stage of development in the Jura; then retrogression begins, and, steadily gaining, finally affects all forms of the type, and it becomes extinct. Smaller series of the Ammonoidea and Nautiloidea go through the same process in their respective time-limits, and in the same way, but can be compared with the individual much more accurately and closely. It is evident, then, that the comparison of the life of an individual with that of its immediate series or group reaches a high degree of exactitude, and that the observed phenomena of the life of an individual should enable us to explain, in some measure, the equivalent phenomena of the life of the group; and we are unavoidably led to entertain the expectation that it does explain it. This expectation was actually formulated as a probable law for the whole animal kingdom by Haeckel in the same year (1866) as the author first published on the Tetrabranchiata. We are therefore able to quote this leader in science in support of our weaker knowledge; and also a pupil of his, Wurtemburger, who has announced the same results attained by researches on the Ammonites of the Jura, but, naturally perhaps, omitted to recognize any one but his honored master.

The evidence is very strong, that there is a limit to the progressive complications which may take place in any type, beyond which it can only proceed by reversing the process, and retrograding. At the same time, however, the evidence is equally strong, that there are such things as types which remain comparatively simple, or do not progress to the same degree as others of their own group. Among Nautiloidea and Ammonoidea these are the radical or generator types. We have no case yet of a highly complicated, specialized type, with a long line of descendants traceable to it as the radical, except the retrogressive: but all our examples of radicals are taken from lower, simpler forms; and these radical types are longer-lived, more persistent, and less changeable in time, than their descendants.

We find the radicals of the Nautiloidea living throughout the paleozoic, and perpetually evolving new types in all directions; then this process ceases, and the primary radicals themselves die out. But they leave shells, which are in that stage of progression which I have called the nautilian. These, the more direct descendants of the radicals, become secondary radicals, and generate series having more involute shells. These, in turn, as secondary radicals, exhibit very decidedly a greater chronological distribution than their descendant involute forms, persisting, even to the present day, in Nautilus umbilicatus. The same story may be told of the Ammonoidea, but substituting at once the close-coiled shell (the secondary radicals) for the primary radicals of the Nautiloidea, even as far back as the Cambrian. These secondary radicals, greatly modified but still carrying in their simpler organizations and mode of coiling the possibilities of a number of new series, existed by the side of the expiring degraded forms of the cretaceous.

This is the essential element of difference between the life of the whole order and that of

[1] We are aware of the existence of evidence that Ammonites of the normal form, the types of which we have seen, have been described from the lower tertiaries: but there are still doubts about the reputed age of the formations; and, in any case, they only tend to confirm the general trend of the facts.

the individual. We can accurately compare the rise and fall of the individual and its whole cycle of transformations with that of any of the single series or branches of the same stock which become highly specialized and then degenerated; but, when we attempt to go farther, we meet with similar difficulties to those encountered in tracing the progress of types and orders. The radical and persistent types are still present, and teach us, that, as long as they exist sufficiently unchanged, new types are a possibility. We have traced many of these in the two orders, and have found that they change and become more complicated, and that probably a purely persistent or entirely unprogressive type does not exist among the fossil Cephalopoda. The most celebrated example of unchanging persistency has been, and is now supposed to be, the modern Nautilus. We think, however, that when our observations are fully published, it will become evident that the similarities of this shell to some of the Cambrian coiled forms — which have caused Barrande and others to suppose that it might be transferred to the Cambrian fauna without creating confusion — belong to the category known to the naturalist as representation; that is, similarities of form, and even of structure, in the adults, but with young having entirely distinct earlier stages of development, and belonging to distinct genetic series. Still, comparative unprogression or persistency is common in all radicals; and they force us to recognize the fact, that the orders could have produced new series, perhaps even in the cretaceous, if it had not been for the direct unfavorable action of the physical changes which then took place, so far as we now know, over the whole earth.

Thus, in making our comparisons between the life of the individual and the life of the group, we cannot say that the causes which produced old age and those which in time produced retrogressive types were identical: we can only say, that they produced similar effects in changing the structures of the individual and of the progressive types, and were therefore unfavorable to the farther development and complication of these types. In their effects they were certainly similar; but in themselves they might have been, and probably were, quite different, agreeing only in belonging to that class of causes which we distinguish as pathological, or those whose nature can be generally summed up as essentially unfavorable to the progress, and even to the existence, of the organization.

In order to understand the meaning of these evidently degraded structures, we must turn back to our first remarks upon the order. The apertures and forms of the retrogressive shells all show that they were exceptional, that they had neither well-developed arms for crawling nor powerful pipes for swimming; that, in other words, they could not have carried their spires in any of the ordinary ways. Their habitats, therefore, must have been more or less sedentary; and like the sedentary Gastropoda, as compared with the locomotive forms, they presented degeneration of the form and structure of their higher and more complicated ancestors. Their habitats did not require the progressive grades of structure, and they dispensed with or lost them; and in many cases this took place very rapidly. This retrogression was in itself unfavorable to a prolonged existence; and the geratologous nature of the changes tells the same story, so that we can attribute their extinction to the unfavorable nature of their new habitats, and also call them pathological types without fear of misrepresenting their true relations to other forms.

We have necessarily avoided even allusions to some of the most important confirmatory facts; but we hope our effort will at least show that the theory advanced is a reasonable one, and that the fossil Cephalopoda are worthy of the attention of even the most enthusiastic of the young disciples of the modern school of embryology. The theories of this school will have to stand tests of which they have now not even a faint idea, and it is to be hoped they will not long neglect the precaution of knowing also the past history of the types they often so incautiously and confidently handle.

ALPHEUS HYATT.

THE MOTION OF WAVES OF COLD IN THE UNITED STATES.

THE chief signal-officer of the army desiring to learn the progress of waves of cold across the United States, an investigation has been undertaken in order to determine the appearance of such waves, their approximate velocity, and general line of advance. It would seem, at first sight, as though the problem might be solved by drawing isotherms (i.e., lines through points at the same temperature) on consecutive days, from simultaneous observations over the whole country. If, then, there were a progressive motion, the study of these lines would show it. It has been found, however, that a cold wave does not travel in a well-defined closed curve; and, more than that, the gradual increase of temperature, as the curves approach

the south, masks and often obliterates the motion we seek to find. Again: such waves are frequently divided, then united, thus by the loss of their identity making it impossible to trace them for a long period. One of the simplest methods of procedure in an investigation of this nature would be the projection of the observations of temperature in curves, one for each station, and then studying the fluctuations from station to station. This was done by Professor Elias Loomis, in his ninth paper, in which he investigated the motion of waves of high and low pressure.

An investigation of this kind, a short time since, gave 19.8 days for the mean interval of time of sixteen waves, moving from St. Michael's, Alaska, to Turuchansk, Siberia, along the sixty-fifth parallel, or an approximate mean velocity of 15.8 miles per hour. Such a determination, however, cannot be regarded as entirely satisfactory, because it simply takes into account a series of stations lying in an east and west direction.

In order to extend the investigation to a large number of stations, we may take daily 'departures' from the monthly mean, and, projecting these upon charts, determine the character of the fluctuations over a large area. In practice, however, this method fails, for the reason that the fluctuations diminish toward southerly latitudes, thus masking the progressive motion.

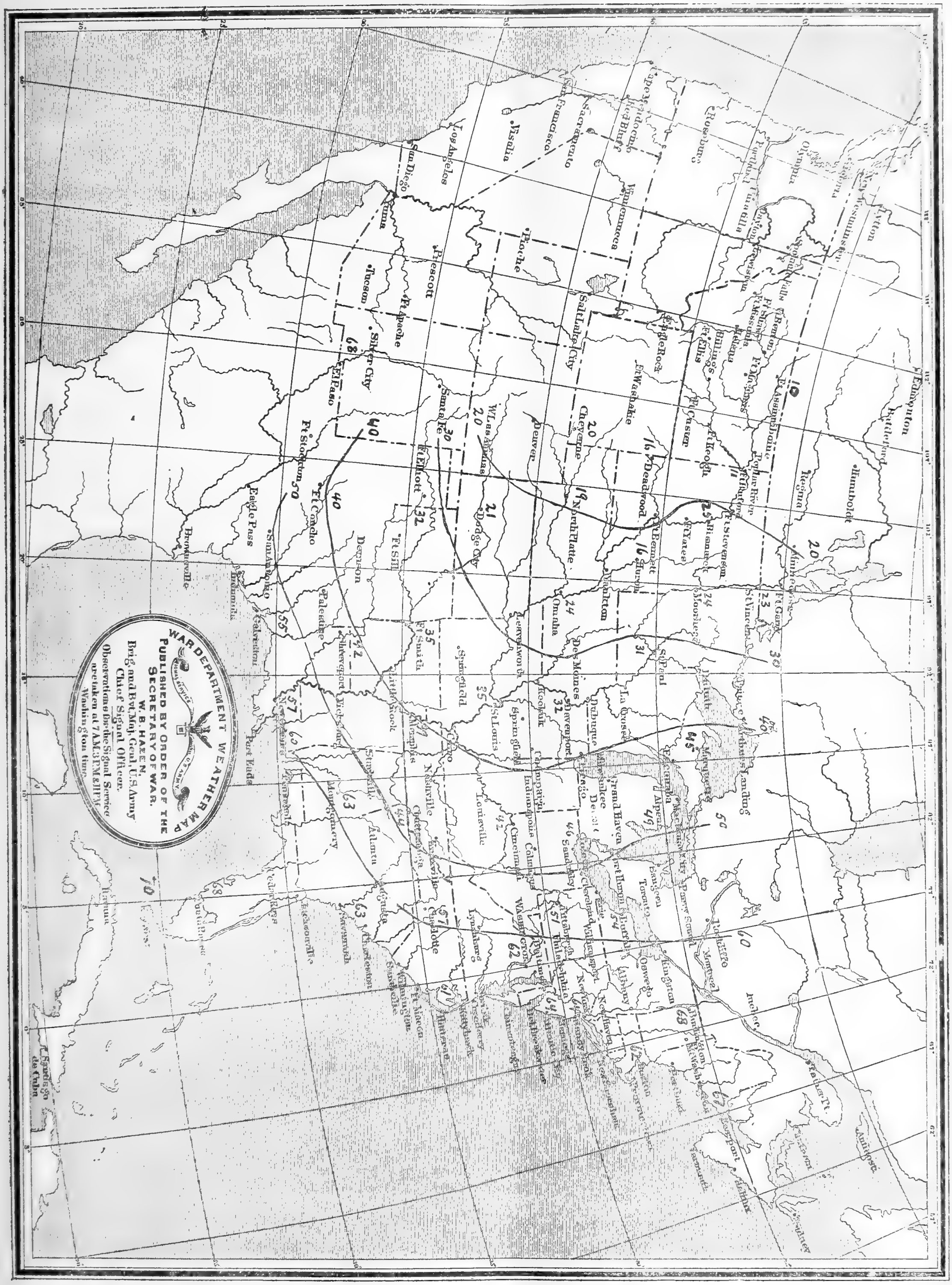
The following method has been adopted for obviating the latter difficulty. We may consider, that if a cold wave advance in any direction, without disturbance from dense clouds or mountain ridges, it will carry minimum temperatures to successive stations in its path; the intervals of time between the passage of such a minimum over any one station taken as a starting-point, and others in the line of progress, gradually increasing. By determining, then, the time of passage of a minimum across each station in a country, and charting these times, we can ascertain both the line of advance and the velocity of the wave.

In order to obtain the time of passage of a minimum temperature over a station, where a series of observations has been made each day, it is essential first to eliminate the effect of diurnal range. This may be done by obtaining the residuals for each observation of a month, taken at any hour; then, determining the approximate time of passage, we can, by examining the successive residuals near that time, obtain the time sought. An effort has been made to apply the above principles to the observations of the U. S. signal-service, taken five times each day during November, 1881, at forty-two selected stations. In this month there were four prominent cold waves; and the following table gives the interval of time which elapsed between the passage of each of these over Fort Dunvegan, North-west territory, and each of the forty-two stations. These figures are inserted exactly as determined from the observations. It was found, however, that many of the apparent discrepancies in a progressive law of motion were due to the appearance of clouds at the time of an observation, thus throwing the minimum forward or back four and even eight hours. Blanks indicate that the minimum could not be determined satisfactorily.

Cold waves, I., II., III., and IV., of November, 1881.

Station.	Hours between Fort Dunvegan and stations in U. S.				
	I.	II.	III.	IV.	Mean.
Alpena, Mich.	48	32	52	64	49
Bismarck, Dak.	24	12	16	48	25
Boston, Mass.	64	52	60	72	62
Brownsville, Tex.	48	64	32	64	52
Buffalo, N.Y.	36	56	48	76	54
Burlington, Vt.	64	–	–	72	68
Cape May, N.J.	48	72	64	72	64
Charlotte, N.C.	56	48	52	72	57
Chattanooga, Tenn.	32	48	40	56	44
Cheyenne, Wyo.	–	–	12	28	20
Cincinnati, O.	32	28	52	56	42
Concho, Tex.	–	–	32	48	40
Davenport, Io.	24	24	32	48	32
Deadwood, Dak.	–	0	8	40	16
Dodge City, Kan.	32	8	12	32	21
Eastport, Me.	72	56	64	76	67
El Paso, Tex.	80	72	56	64	68
Fort Assinaboine, Mont.	24	0	– 8	24	10
Fort Buford, Mont.	20	0	–16	40	11
Fort Elliott, Tex.	32	16	32	48	32
Fort Gibson, Ind. Ter.	32	24	28	56	35
Galveston, Tex.	72	48	48	52	55
Huron, Dak.	–	8	8	32	16
Key West, Fla.	64	–	–	76	70
Kitty Hawk, N.C.	56	56	56	76	61
Marquette, Mich.	40	48	40	52	45
Memphis, Tenn.	32	24	48	52	39
Montgomery, Ala.	56	–	56	76	63
Moorhead, Minn.	24	24	0	48	24
New Orleans, La.	–	48	52	72	57
North Platte, Neb.	–	8	16	32	19
New York, N.Y.	48	72	56	80	64
Omaha, Neb.	–	8	24	40	24
Pittsburg, Penn.	52	56	48	48	51
Punta Rassa, Fla.	48	–	84	72	68
St. Louis, Mo.	32	24	32	52	35
St. Paul, Minn.	24	24	36	40	31
St. Vincent, Minn.	24	16	24	28	23
Savannah, Ga.	52	72	56	72	63
Shreveport, La.	–	–	32	52	42
Toledo, O.	28	30	52	76	46
Washington, D.C.	56	48	72	72	62

Projecting the mean interval for the four waves upon a chart (see accompanying plate).



MOTION OF WAVES OF COLD, NOVEMBER, 1881. THE RATE OF MOTION IS GIVEN IN HOURS FROM FT. DUNVEGAN, B.C.

and taking Fort Assinaboine as a starting-point, we obtain the following lines of advance: —

Hours from Fort Assinaboine.

10.	20.	30.	40.	50.
St. Vincent, Minn.	Duluth, Minn.	Marquette, Mich.	Erie, Peun.	Rochester, N.Y.
Huron, Dak.	St. Paul, Minn.	Milwaukee, Wis.	Pittsburg, Penn.	Washington, D.C.
North Platte, Neb.	Leavenworth, Kan.	Chicago, Ill.	Knoxville, Tenn.	Charlotte, N.C.
Cheyenne, Wyo.	Fort Sill, Tex.	Memphis, Tenn.	Vicksburg, Miss.	Augusta, Ga.
	Santa Fé, New Mex.	Denison, Tex.	Brackettville, Tex.	Mobile, Ala.
		Concho, Tex.		

This shows that in November, 1881, the cold waves were about two days in travelling from Fort Assinaboine to Washington. It would be an interesting comparison if a like investigation were undertaken for waves of heat, also, during other months of the year. A similar method may be applied to the advance of waves of high and low pressure, with the great advantage that clouds would not interfere with the determination of the time of passage.

This subject has attracted much attention from time to time, and recently it has been taken up by Mr. A. N. Pearson of India (*Nature*, Aug. 9, 1883).

The chief signal-officer has kindly permitted this publication in advance of a more extended investigation. H. A. Hazen.

TISSANDIER'S ELECTRIC BALLOON.[1]— I.

In describing recently the new hydrogen-gas apparatus which we had constructed in our workrooms at Paris-Auteuil, we mentioned that the governable electric balloon, which has been in preparation since the electrical exposition, was ready for trial. This took place the 8th of last October.

The arrangement of the controllable electric balloon consists of three distinct pieces of apparatus, — the air-balloon, properly so called; the gas apparatus to inflate it; and the electric motor to supply freedom of motion by means of a screw.

The construction of an elongated aerial ship presented serious difficulties. We were aided by two experiments, — that of Mr. Henri Giffard in 1852, and that of Mr. Dupuy de Lôme in 1872. In the model which we tried at the time of the electrical exposition, we arranged for the suspension of the little boat a low rod, running longitudina similar to that of the air steamship of Mr. Giffard. We afterward concluded that it would be better to place the screw behind a large parallelopiped-shaped boat, high enough to protect the propeller against the danger of a shock on descent. The boat, in this case, is connected to the balloon by suspension-cords running obliquely; and the deformations of the arrangement are escaped by means of a flexible shaft fixed at either side of the balloon. The balloon was constructed by my brother, in the rooms of Mr. H. Lachambre, to whom was intrusted the making of the new air-ship. A model 15 cubic metres in capacity was first made; and, after studying the action of this in a captive state, the construction of the large balloon (fig. 1) was begun. Its shape was like that of Mr. Giffard's and Mr. De Lôme's balloons: it was 28 metres long, and 9.2 metres in diameter through the middle. On its lower surface, there is a cone with an automatic valve: it is made of a thin cloth, rendered impermeable by a new varnish prepared by Mr. Arnoul of Saint-Ouen-l'Anmône. The capacity of the balloon is 1,060 cubic metres.

The netting over the balloon is formed of ribbons woven with longitudinal spindles, which keep them in their proper geometric positions. The ribbons thus easily adapt themselves to the inflated material, and do not form projections, as do the meshes of a net. The netting is connected on the sides of the balloon with two flexible shafts, which perfectly conform to its shape, passing along the centre of each side. The shafts are made of thin walnut laths fitted with bamboo: they are connected by silk belts. At the lower end of the netting are intersecting rods, at the ends of which are twenty suspension-ropes connected in groups of five to the four upper corners of the car. This latter is in the form of a cage made of bundles of bamboo rods, strengthened by cords and threads of copper covered with gutta-percha. The lower part is made of walnut cross-pieces, which support the willow basket. The suspension-ropes entirely cover the boat: they are woven into the basket, being previously sheathed in caoutchouc, which, in case of accident, protects them from the acid liquid contained in the boat to feed the batteries. The suspension-ropes are connected horizontally by rigging about two metres above the boat. The guide and anchor ropes are attached to this rigging, which also serves to equally distribute the traction during the descent. The rudder, a broad surface of unvarnished silk supported by bamboo, is also arranged behind. The weights of the different parts are as follows: —

[1] Translated from *La Nature*.

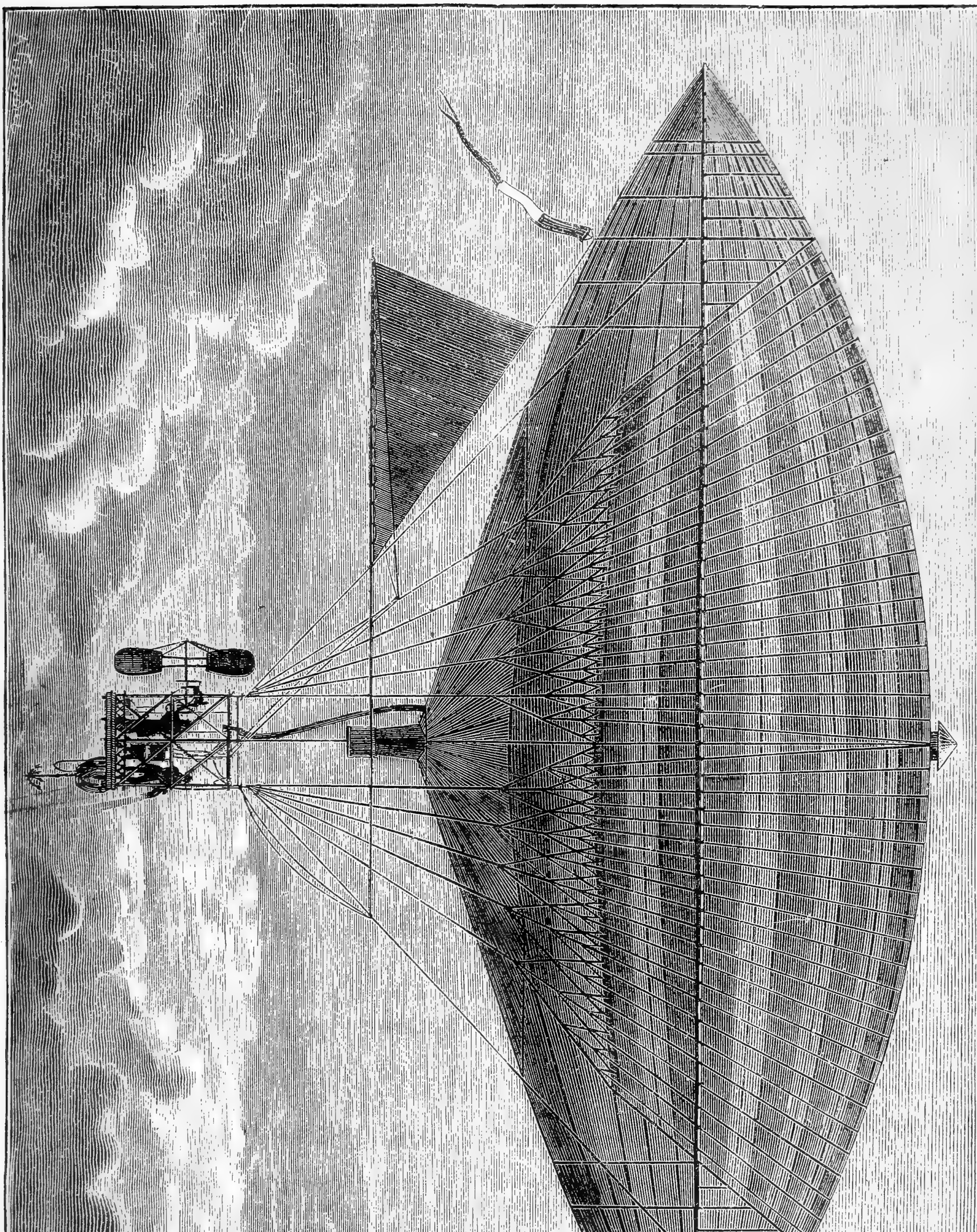


FIG. 1.—TISSANDIER'S FLYING BALLOON AS USED, OCT. 8, 1883.

	Kilograms.	
Balloon, with the valves	170	
Cover, with rudder and suspension-ropes	70	
Flexible side-shafts	34	
Car	100	
Motor, screw, and batteries, with liquid for 2 h. 30 m.	280	
Stopping-machinery (anchor and guide rope),	50	
Weight of material		704
Two passengers, with instruments		150
Ballast		386
Total weight		1,240

Allowing 10 kilograms, the lifting-force was 1,250 kilograms. The capacity of the balloon being 1,060 metres, the gas had a lifting-force of 1,180 grams per cubic metre, — a result not hitherto obtained in the production of large quantities of hydrogen.

By the end of September the gas apparatus was ready for trial; the balloon was stretched out on the ground under a long tent, in order that it might be immediately inflated; the boat and the motor were stowed under a cart-house; and my brother and I were only awaiting good weather to make the trial. On the 6th of October there was a rise of barometer; on the 7th the weather was fine, with light wind; and we decided to make the experiment the following day, Oct. 8, 1883.

The inflation of the balloon began at eight o'clock in the morning, and continued, without pause, till half-past two in the afternoon. This operation was expedited by means of the equatorial ropes hanging at the right and left of the balloon, and to which were attached the ballast-bags. (The ropes are shown in fig. 2, which also presents the spindle-shaped balloon as seen from one end.) The inflation completed, we proceeded to arrange the boat and the ebonite tanks, each of which contains thirty litres of the acid solution of bichromate of potassium. At twenty minutes past three, having heaped in the ballast and obtained equilibrium, we were slowly raised into the air, a light east-south-east wind blowing. On the ground there was almost no wind; but, as frequently happens, it increased with the altitude; and we found, when the balloon had risen five hundred metres, that it attained a velocity of three metres a second.

My brother was especially engaged in regulating the ballast, in order to keep a constant low altitude. The balloon was kept very regularly at a height of four or five hundred metres. It remained perfectly inflated; and the superfluous gas escaped by opening, under its pressure, the automatic valve, the action of which was very uniform.

Several minutes after the departure, I tried the bichromate of potassium batteries, composed of four troughs with six compartments, making twenty-four elements in circuit. A mercury commutator enabled us to use at pleasure six, twelve, eighteen, or twenty-four elements, and thus to obtain four different speeds of the screw, varying from sixty to a hundred and eighty revolutions per minute. With twelve elements, we found that the speed of the balloon was insufficient; but above the Bois de Boulogne, when our motor was working with great speed, with twenty-four elements a very different effect was produced. The movement of the balloon became suddenly appreciable, and we felt a fresh breeze produced by our horizontal motion. With the balloon head to the wind, pointing toward the belfry of the church of the Auteuil, near our starting-point, we remained

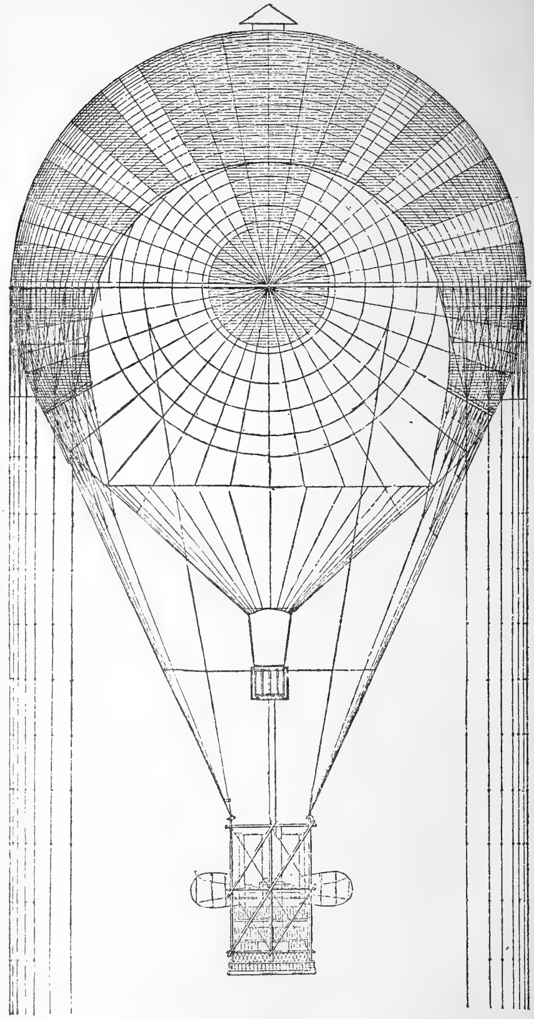


FIG. 2.

motionless, as we proved by noting conspicuous points beneath our car. Unfortunately it did not long maintain this position; but, after acting well for several instants, it suddenly began gyratory motions which the rudder was powerless to completely control. In spite of the rotations which in later trials we were able to prevent, we tried the same experiment for more than twenty minutes, during which we could perceive that we were over the Bois de Boulogne. When we tried to change our position by cutting the wind perpendicularly to its direction, the rudder became inflated like a sail, and the rotations were produced with much greater violence. From this we

assume that the position which an air-ship ought to occupy should be such that its major axis may make with the line of the wind an angle of several degrees.

After the experiments we have just described, we stopped the motor, and the balloon passed over Mont-Valérien. Once, when it had taken the direction of the wind, we began again to turn the screw, proceeding this time with the current. The speed of the balloon was increased, and by means of the rudder we were now easily able to turn to the right or left from the line of the wind. We proved this by taking, as before, some point on the surface; and several spectators also verified it.

At thirty-five minutes past four we made the descent in a large plain near Croissy-sur-Seine. The operation of landing was conducted by my brother with great success. We left the balloon inflated over night, and the next day it had not lost the least gas. Painters and photographers were enabled to obtain views of our air-ship, which was surrounded by a numerous and sympathetic assembly which the novel sight had attracted from all sides.

We had intended to make a new ascent on this day: but, on account of the cold of the night, the bichromate of potassium in our ebonite tanks had crystallized; and the battery, which was by no means exhausted, was on this account, however, incapable of action. We drew the balloon to the shore of the Seine, near the bridge of Croissy; and there, to our great regret, we were obliged to discharge the gas, and to lose in a few instants what had required so much care in its preparation.

Without describing in greater detail our return, we have concluded from this first trial that, 1°, electricity furnishes a balloon with the most convenient power, the management of which in the car is remarkably easy; 2°, in our own case, when our screw, 2.8 metres in diameter, made a hundred and eighty revolutions per minute, we were able to keep head to a wind moving three metres per second, and, when proceeding with the current, to deviate from the line of the wind with great ease; 3°, the mode of suspension of a car from an elongated balloon by means of bands running obliquely, and supported by flexible side-shafts, insures perfect stability to the whole.

We ought to say that our ascent of Oct. 8 should be considered only as a preliminary trial, which will be repeated with the alterations which our experience commends. In addition, we would mention that there was in the car a considerable excess of ballast, and that eventually it will be possible for us to use a much more powerful motor. Aerial navigation will not be made practicable through a single attempt: it will require many trials and efforts and great perseverance under every ordeal.

(*To be continued.*)

THE DISCOVERY OF THE GERM OF SWINE-PLAGUE.

IN a communication read before the Paris academy of sciences, Nov. 26, 1883, by M. Pasteur, the following paragraph occurs: —

"As soon as I received his [Thuillier's] first letters from the commune of Peux, in the department of Vienne, it was certain that he had perceived in the blood and humors of the dead hogs a new microbion which it seemed should be the author of the disease. This microbion had escaped the observation of Dr. Klein of London, in the course of a long and remarkable account of autopsies and experiments published three years before in the report of the English sanitary office. Dr. Klein stated that a microbion was the cause of the affection; but he committed an error, for the microbion that he described has no connection with the cause of *rouget*. Thuillier by his observation had overcome the principal difficulty to a knowledge of this disease of the hog. Historic truth, however, obliges me to declare, that in 1882, and also in the month of March, the microbion of *rouget* was signalled at Chicago, in America, by Professor Detmers, in a paper which does great honor to its author. Thuillier could not have been acquainted with this paper, and I myself only learned of its existence very recently. The observation of the microbion of *rouget* of the hog by Thuillier dates from the 15th of March, 1882."[1]

It is so very seldom that investigations on this side of the water receive any notice whatever abroad, and particularly in France, that it seems a pity even to call attention to the very great injustice done to American work in the above statement, since any recognition at all is so much better than being quietly ignored. There is, however, so much of general interest in regard to the gradual development of our knowledge of the germ of this disease, so much of interest in the success and failures of those who have worked upon it, that, aside from our desire to see history correctly written, there is sufficient incentive for tracing the progress of this study, which commenced when the first real light was breaking upon the germ-theory of disease.

Dr. Klein deserves more credit for his share in the discovery of the micrococcus of swine-plague than M. Pasteur seems inclined to grant. In 1876 he published one of the first, if not the very first, reliable microscopic studies of this disease. The care and skill shown in this investigation are more apparent to-day than when the details were first published; and, although he subsequently made the unfortunate mistake of attributing the cause of the disease to a bacillus, this fact should not be allowed to weigh against his former and really valuable researches.[2]

In his account of the microscopic appearances of the intestine, the following sentence occurs: —

"From and even before the first signs of necrosis of the mucosa, viz., when the epithelium begins to break down and be shed from the surface, there are found masses of micrococci, which in some ulcers occupy a great portion of the *débris*."[3]

A little farther on he says, —

"There is one more point which I believe deserves careful attention. In the ulceration of the tongue just mentioned, and at a time when the superficial scab has not become removed, I have seen masses of micrococci situate chiefly in the tissue of the papillae, but at some places reaching as far deep as the inflam-

[1] *La vaccination du rouget des porcs à l'aide du virus mortel atténué de cette maladie.* PASTEUR et THUILLIER. *Comptes rendus*, xcvii. p. 1164.

[2] Report on the so-called enteric or typhoid-fever of the pig, by DR. KLEIN. In Reports of the medical officer of the privy council and local government board. New series, No. VIII. Report to the Lords of the council on scientific investigations, etc., 1876, pp. 91-101.

[3] Loc. cit., p. 98.

mation extends. That they are micrococci was proved by their forming lumps of uniform granules; these lumps stain deep purple-blue in haematoxylin, and are thus very conspicuous, and besides resist the action of caustic potash, with which all the rest of the tissue disappears. These heaps of micrococci in locality correspond to the papillae, and are on the surface of the scab, but underneath the covering epithelium, some parts of this having changed into a dry, hard, discolored mass, others containing larger or smaller vesicles filled with fluid."[1]

In the examination of the respiratory organs we are given even stronger evidence for connecting these organisms with the cause of the disease. In the mucous membrane of the anterior surface of the epiglottis, which was only slightly inflamed in its submucous tissue, he found —

"Lymphatic vessels filled with micrococci. . . . In the infiltrated, firm, more or less disintegrating parts [of the lung] I find great masses of micrococci filling up capillaries and veins, and also contained in lymphatics around arteries.[2] . . . The pleura is much swollen, and contains great numbers, continuous layers, of lumps of micrococci. The free surface of the membrane is in many parts covered with them. The exudation fluid is also charged with them as has been mentioned above."[3]

We have here the record of the unbiassed *savant* seeking after the truth, and describing what he sees without any attempt to draw conclusions or build up theories. It was before Koch's brilliant investigations, identifying the Bacillus anthracis as the active principle in charbon virus, had seen the light. There was still the greatest doubt as to whether the contagia were essentially animal cells, vegetable organisms, or chemical poisons. It would have been premature to have presented the micrococci at that time as the cause of the disease, though it is evident from these observations that they existed in the tissues of the body before the death of the animal. We have consequently two questions to consider in an inquiry of this kind; viz., (1) Who is entitled to priority for discovering and demonstrating the presence of micrococci in the tissues and liquids of diseased animals? and (2) Who was first in proving the connection between the micrococci and the essential constituent of the virus?

It seems very evident that Dr. Klein discovered the micrococci as early as 1876, but it is equally evident that his investigations were not sufficient to show that this parasite was the cause of the disease. The fact that from later observations, of an entirely different nature, he attributed the cause to another organism, surely can at this day detract nothing from the merits of the paper from which I have just quoted; and it must consequently be acknowledged as a matter of historical truth, the data of which are fully recorded, that Klein discovered the micrococci of swine-plague long before they were seen by Pasteur and Thuillier.

We can now pass to a brief consideration of the investigations which were intended to connect certain organisms found in the tissues or liquids of diseased and dead animals with the cause of the disease.

In 1878 a second and very elaborate report was made by Dr. Klein,[4] in which he gives experiments that are supposed to demonstrate the pathogenic nature of a specific bacillus found in certain liquids of diseased hogs, and cultivated for several generations in the aqueous humor from rabbits' eyes. Coming so soon after the publication of Koch's remarkable studies of the life-history of the anthrax bacillus, and agreeing so closely with them in all important respects, it is scarcely to be doubted that the earlier conclusions had more or less influence in shaping the later ones. While it might be interesting to the specialist to enter into details in regard to the defective methods of cultivation used, the unsatisfactory results of the microscopic examination of the tissues and fresh liquids for the bacilli, and the still more unsatisfactory results of the inoculation experiments with the cultivated organisms, our space will not permit this at present. In behalf of a most indefatigable worker, however, I would call attention to the fact that this mistake of Klein's was not so extraordinary as it may appear to many to-day, because the methods of cultivating and studying disease-germs have to a large extent been perfected since that time.

In the same year a number of persons were appointed by the U. S. commissioner of agriculture to investigate the disease known in this country as hog-cholera. The greater part of these served but two months; but Dr. Detmers, having reported the discovery of the disease-germ, was allowed to continue his investigations. In his first report, Dr. Detmers stated that the disease was caused by a bacillus, which he named Bacillus suis, because the same, so far as he was able to learn, was peculiar to and characteristic of swine-plague.[1] He saw micrococci, but regarded them as bacillus germs: indeed, he states that he constantly observed one of these under the microscope while it "budded, and grew to double its length, in exactly two hours."[2]

This report of Dr. Detmers, coming so soon after Klein's, and attributing the virulence to a bacillus of substantially the same characters as that described by Klein, while the latter's micrococci were made to do duty as bacillus germs, — a relation which had been previously ascribed to them by the medical officer in his 'preliminary note,' though it was not suggested by the English investigator himself, — did much to confirm the bacillus theory, and to convince scientific men that the parasite of another contagious fever had actually been isolated, and its connection with the disease demonstrated.

In January, 1880, M. Mégnin published the results of a microscopic examination of the blood in this disease, in which he described and figured a micrococcus.[3] This organism existed in single granules, and also in clusters and chains, and agreed so closely with one subsequently studied by me that I reproduced the drawings of it in connection with my report written the following December.[4]

[1] Loc. cit., p. 99. [2] *Ibid.*, p. 100. [3] *Ibid.*, p. 101.

[4] Report on infectious pneumo-enteritis of the pig (so-called pig-typhoid), by Dr. E. Klein, F.R.S. Report of the medical officer of the local government board. London, 1877 and 1878, pp. 169-290.

[1] Department of agriculture. Special report, No. 12, 1879, p. 42.

[2] Loc. cit., p. 53.

[3] Recueil de médecine vétérinaire, 1880, pp. 36, 37.

[4] Department of agriculture. Special report, No. 34, pp. 80, 81, plate IX.

In his second report,[1] Dr. Detmers does not seem to have materially modified the views referred to above, though he had been studying the disease during the whole of another year. In discussing accepted classifications in his supplemental report, he says, —

"All, however, seem to agree, that those Schizomycetes classed by them under the name of 'Bacillus' do not form clusters or colonies (rasen, zoogloea-masses, gliacoccus, orcocoglia), and do not undergo metamorphoses from globular to rod-shaped Schizomycetes, two things decidedly characteristic of the microscopic parasites of the Schizomycetes family as found in swine-plague; consequently the name adopted, Bacillus, was not well chosen and is not suitable."[2]

As I have shown elsewhere,[3] the two points referred to would not exclude an organism from the genus Bacillus. The best-known bacilli certainly develop from resting spores of an oval form, as seen under the microscope: some of these spores approach very closely to the globular; and, if they should be perfect spheres, the classification would not be affected in the least. The other point — that an organism, multiplying as a micrococcus, after a time develops into a rod-shaped body — is an idea, that, although it is persistently pressed in some quarters, has never been accepted by the best authorities, and is no more true of the organism in question than of other forms of micrococci, as I have assured myself by long series of cultivations. The fact of greatest importance to the present inquiry is, that up to this time Dr. Detmers considered the organism of swine-plague to be rod-shaped in its developed form. This supplemental report, in which the first doubts are expressed in regard to the organism being a real bacillus, was dated six weeks after the appearance of Mégnin's paper, and was not distributed for seven or eight months subsequent to this. It is to be remembered, also, that in none of the above investigations were any sufficient precautions taken to exclude atmospheric germs from the liquids examined, and no pure cultivations were made. It was therefore a matter of considerable doubt whether the organisms described were really in the blood as it circulated in the living animal, or whether they were introduced *post mortem.*

The third report of Dr. Detmers bears the date of Dec. 4, 1880.[4] In this it was stated that the "swine-plague Schizophytae present themselves in different shape and form." The simplest form is that of a micrococcus. The second form is bispherical: the spherical cell has grown and become contracted, or indented in the middle, forming two united granules.

"These bispherical Schizophytae are always more or less numerous, are either at rest or moving, and usually provided at one end with a flagellum or post-flagellum, which, however, is so exceedingly fine that I have never seen it except with the $\frac{1}{15}$ homogeneous immersion objective of Tolles, and an amplification of over 1,500 diameters, and then only while the Schizophytae was moving."[5]

[1] Department of agriculture. Special report, No. 22, pp. 13–67.
[2] Loc. cit , p. 60. [3] Special report, No. 34, p. 68.
[4] Special report, No. 34, pp. 153–195. [5] Loc. cit., p. 187.

He then goes on to describe the formation of a chain of bispherical elements, and mentions the existence of zoogloea masses as well. He had not yet given up the rod or bacillus form: for he states that in the blood and pleural exudation, when a day or two old, and sometimes while yet fresh, rod-shaped bacteria can be observed; and it appears probable that the same constitute another form of the swine-plague Schizophytae.[1]

The same volume contained a report of mine in which are detailed certain experiments and observations on the schizophytes peculiar to this disease. In this report was given a description of the first successful attempts, as I believe, to demonstrate what micro-organisms, if any, existed in the blood and other liquids of living hogs sick with swine-plague. To keep the liquids to be examined free from all suspicion of contamination, vacuum tubes were prepared by drawing to a point the two ends of a small piece of glass tubing about a fifth of an inch in diameter. A drop or two of water was then aspirated into this tube, boiled to secure a vacuum, and the ends immediately sealed. The tube was now heated to redness to destroy any bacteria spores that might still be in it, and it was ready for filling with the virulent liquid. In use, a very sick hog was killed, a vein laid bare, sometimes before the animal was quite dead, the vacuum tube was passed through the flame of an alcohol lamp, the finely drawn-out end forced into the vein and broken across its walls, when it would immediately fill, and was sealed in the lamp as soon as withdrawn.[2] It is plain that such tubes could be preserved indefinitely for examination without any suspicion of atmospheric contamination. The only change that could occur would be due to a continued multiplication, — a kind of cultivation of the organisms which had existed in the blood of the living animal.

Three separate outbreaks of swine-plague at widely separated points were investigated; and in every one, I found, by the method of study just referred to, that the virulent liquids contained micrococci, single, and in chains and clusters, but never rod forms, except in those cases where the tubes did not fill well, or where they were imperfectly sealed. And blood from the most perfect of these tubes, which contained no visible organisms but micrococci, produced unmistakable and severe cases of swine-plague in inoculated animals.[3] These were the first experiments in which the virulent material, preserved free from suspicion of atmospheric contamination, was shown to contain but a single species of schizophytes; and they were consequently the first which indicated any connection between the micrococci and the essential cause of this disease.

In his fourth report, Dr. Detmers states positively that some of the swine-plague organisms develop a lasting spore, and are changed into a helobacterium.[4] But there is no account of any measures adopted to decide which of the forms observed in the impure liquids examined had existed in the body of the

[1] Loc. cit., p. 188. [2] *Ibid.*, p. 22. [3] *Ibid.*, pp. 23, 24.
[4] Department of agriculture. Annual report, 1881 and 1882.

living animal; nor was there any substantial reason given for considering the helobacterium as belonging to the same species as the micrococci, or, if they happened to be different, which, if either, was able to cause the disease.

The same volume contains my report bearing the date of Jan. 27, 1882. In this are details of successful inoculation experiments with the sixth pure cultivation of micrococci which had been obtained and cultivated with every precaution known to science at the present day.[1] It was the first real evidence of the pathogenic action of these organisms. It was equally satisfactory with the experiments of MM. Pasteur and Thuillier; and the inoculations were made Jan. 17, 1881, or fourteen months before the discovery of this same organism by these gentlemen.

The communication of Dr. Detmers, referred to by M. Pasteur, appeared in the *American naturalist* for March and April, 1882, and was a *résumé* of his studies for the department of agriculture. In this article he still thinks there is just cause to suppose that the organism of swine-plague has a helobacterium, or rod form, and a resting spore. There are, however, no new observations or experiments referred to, there is no additional proof that the micrococci seen by him were not the result of atmospheric contamination, — nothing to show that a pure cultivation of these would produce the disease. On the other hand, the organism which he describes possesses a flagellum, and a moving stage or period, neither of which have I been able to observe with the true germ of this disease, nor with the closely allied micrococcus which causes fowl-cholera.

It is a matter of record, therefore, that the organism which constitutes the cause of swine-plague was first discovered by Klein in 1876, but that he failed to connect it in any way with the virus of the disease, and afterwards concluded that it depended upon a very different schizophyte. It is also a matter of record that I was the first to demonstrate by satisfactory methods that this micrococcus exists in the blood during the life of the animal, that it can be cultivated in flasks, and that the sixth successive cultivation, made in considerable quantities of liquid, and which contained no other form than micrococcus, still produced the disease. Neither Pasteur and Thuillier, nor any other investigators that I am aware of, have added one particle of evidence, except by way of confirmation, to that previously advanced by me. M. Pasteur is usually very particular in giving credit, but he does not seem to be keeping up with the progress of American science. D. E. SALMON.

MIGRATION OF BIRDS IN ENGLAND.[2]

THE general report of the committee of the British association, of which this is in fact an abstract, comprises the observations taken at lighthouses and lightvessels, and a few special land-stations, on the east and west coasts of England and Scotland, the coasts of Ireland, Isle of Man, Channel Islands, Orkney, and Shetland Isles, the Hebrides, Faroes, Iceland, and Heligoland, and one Baltic station (Stevns Fyr, on Stevns Klint, Zealand), for which the committee is indebted to Professor Lütken of Copenhagen. Altogether, a hundred and ninety-six stations have been supplied with schedules and printed instructions for registering observations, and returns have been received from about a hundred and twenty-three, — a result which is very satisfactory, showing, as it does, the general interest taken in the work, and the ready co-operation given by the light-keepers in assisting the committee.

As in preceding years, the line of autumn migration has been a broad stream from east to west, or from points south of east to north of west, and covering the whole of the east coast. In 1880, to judge from the returned schedules, a large proportion of the immigrants came in at the more southern stations; in 1881 they covered the whole of the east coast in tolerably equal proportions; but in 1882 the stations north of the Humber showed a marked preponderance of arrivals. Altogether, a vast migration took place this year upon our east coast; the heaviest waves breaking upon the mouth of the Humber, Flamborough Head, the Farne Islands, Isle of May at the entrance to the Firth of Forth, and again, after missing a long extent of the Scotch coast, at the Pentland Skerries. The Bell Rock also came in for a share, although apparently a much smaller one than the Isle of May. The easterly winds prevailed all along our east coasts, generally strong to gales; and the succession of south-easterly and easterly gales in October, between the 8th and 23d, occurring as they did at the usual time of the principal migration, brought vast numbers of land-birds to our shores. From the Faroes in the north, to the extreme south of England, this is found to have been the case.

Although migration — that is, direct migration — on our east coast is shown to have extended over a long period, commencing in July, and continuing, with but slight intermissions, throughout the autumn and into the next year to the end of January, yet the main body of migrants appears to have reached the east coast in October, and of these a large proportion during the first fortnight in the month. From the 6th to the 8th inclusive, and again from the 12th to the 15th, there was, night and day, an enormous rush, under circumstances of wind and weather, which, observations have shown, are most unfavorable to a good passage. During these periods, birds arrived in an exhausted condition; and we have reasons for concluding, from the many reported as alighting on fishing-smacks and vessels in the North Sea, that the loss of life must have been very considerable. Large flights, also, are recorded as having appeared round the lanterns of lighthouses and lightvessels during the night migration. From the 6th to the 9th inclusive, strong east winds blew over the North Sea, with fog and drizzling rain; and from the night of the 12th to 17th very similar weather prevailed. Mr. W. Littlewood, of the Galloper lightship, forty miles south-east

[1] Loc. cit., pp. 267-269.

[2] Report of the committee of the British association for the advancement of science, appointed for the purpose of obtaining observations on the migration of birds at lighthouses and lightships, and of reporting on the same. (From *Nature*.)

of Orfordness, reports, that, on the night of Oct. 6, larks, starlings, tree-sparrows, titmice, common wrens, red-breasts, chaffinches, and plovers were picked up on the deck, and that it is calculated that from five hundred to six hundred struck the rigging and fell overboard: a large proportion of these were larks. Thousands of birds were flying round the lantern from 11.30 P.M. to 4.45 A.M., their white breasts, as they dashed to and fro in the circle of light, having the appearance of a heavy snow-storm. This was repeated on the 8th and 12th; and on the night of the 13th a hundred and sixty were picked up on deck, including larks, starlings, thrushes, and two red-breasts. It was thought that a thousand struck, and went overboard into the sea. It is only on dark, rainy nights, with snow or fog, that such casualties occur: when the nights are light, or any stars visible, the birds give the lanterns a wide berth.

Undoubtedly the principal feature of the autumn migration has been the extraordinary abundance of the gold-crested wren. The flights appear to have covered not only the east coast of England, but to have extended southward to the Channel Islands, and northward to the Faroes (see report, East coast of Scotland). On the east coast of England they are recorded at no less than twenty-one stations from the Farne Islands to the Hanois lighthouse, Guernsey, and on the east coast of Scotland at the chief stations from the Isle of May to Sunburgh Head; at which latter station they have rarely been seen in previous years. Mr. Garrioch, writing from Lerwick, says, "In the evening of Oct. 9 my attention was called to a large flock of birds crossing the harbor from the Island of Bressay; and, on coming to a spot on the shore where a number had taken refuge from the storm, I found the flock to consist of gold-crests and a few fire-crests amongst them. The gold-crests spread over the entire island, and were observed in considerable numbers till the middle of November." The earliest notice on the east coast is Aug. 6; the latest, Nov. 5, or ninety-two days. They arrived somewhat sparingly in August and September, and in enormous numbers in October, more especially on the nights of Oct. 7 and 12, at the latter date with the woodcock. This flight appears to have extended across England to the Irish coast; for on the night of the 12th a dozen struck the lantern of the Tuscar Rock lighthouse, and on the night of the 13th they were continually striking all night. During the autumn, enormous numbers crossed Heligoland, more especially in October. On the night from the 28th to the 29th, Mr. Gätke remarks, "We have had a perfect storm of gold-crests, perching on the ledges of the window-panes of the lighthouse, preening their feathers in the glare of the lamps. On the 29th all the island swarmed with them, filling the gardens and over all the cliff, — hundreds of thousands. By 9 A.M. most of them had passed on again." Not less remarkable was the great three-days' flight of the common jay, past and across Heligoland, on Oct. 6, 7, and 8. Thousands on thousands, without interruption, passed on overhead, north and south of the island too, — multitudes like a continual stream, all going east to west in a strong south-easterly gale. It would have been interesting if we had been able to correlate this migration of jays with any visible arrival on our English coast, but in none of the returns is any mention made of jays. Subsequently we have received numerous notices of extraordinary numbers seen during the winter in our English woodlands. This seems especially to have been the case south of a line drawn from Flamborough Head to Portland Bill in Dorset. Additions and unusual numbers were also observed at Arden on Loch Lomond side.

The returns show very clearly that the spring lines of migration followed by birds are the same as those in the autumn, but of course in the reverse direction, — from west and north-west to east and south-east. Another point worth noting is the occurrence of many species in spring at the same stations frequented by the species in autumn: thus double records occur at the Mull of Galloway, Bell Rock, Isle of May, as well as at some English [illegible]

As this is the fourth report issued by the committee, we may, perhaps, with the mass of facts at our disposal, be expected to draw deductions which, if they do not explain, may serve at least to throw some light on the causes influencing the migration of birds. We might reasonably reply that the work undertaken by us was not to theorize, or attempt explanations, but simply to collect facts, and tabulate them. This we have endeavored to do in the shortest and simplest manner consistent with accuracy of detail. There is, however, one circumstance which can scarcely fail to present itself to those who have gone carefully into the reports issued by the committee; namely, the marvellous persistency with which, year by year, birds follow the same lines, or great highways of migration, when approaching or leaving our shores. The constancy of these periodical phenomena is suggestive of some settled law or principle governing the movement. It is clearly evident, from the facts already at our disposal, that there are two distinct migrations going forward at the same time, — one the ordinary flow in the spring, and ebb in the autumn, across the whole of Europe. A great migratory wave moves to and from the nesting-quarters of the birds, in the coldest part of their range, — north-east in the spring, and south-west in the autumn. Quite independent of this, there is a continual stream of immigrants, week by week and month by month, to the eastern shores of these islands, coming directly across Europe from east to west, or more commonly four points south of east to north of west, and the reverse in the spring. These immigrants are mainly composed of those common and well-known species which annually make these islands their winter quarters, and, as a rule, take the place of our summer birds. They come in one broad stream, but denser on some special lines or highways than others. Cutting the line of ordinary migration at nearly right angles, one flank brushes the Orkney and Shetland Isles, pouring through the Pentland Firth, even touching the distant Faroes. The southern wing crosses the Channel Islands, shaping its course in a north-westerly direction to the English coast.

SPANG'S LIGHTNING PROTECTION.

A practical treatise on lightning-protection. By HENRY W. SPANG. New York, *Van Nostrand,* 1883. 63 p. 8°.

THIS is a new and enlarged edition of the author's treatise on lightning-protection, published in 1877. The book contains altogether too many good things to be bad, and too many bad things to be entirely good. There is a wholesale condemnation of all systems and methods other than those described, which is a little perplexing, until one discovers, and in fact the author confesses, that it is issued with a view of effecting a general introduction of a *patented* system of lightning-conductors. The business air which pervades the whole is thus clearly explained.

The author frequently pronounces against the 'lightning-rod men and scientists,' attributing the blunders of the former to the mistakes of the latter. A brief examination of his book will suffice to fully acquit him of the charge of belonging to the latter class; and it must be confessed, that the many excellent rules which he has emphasized oblige us to rank him considerably above the general average of the former. The general principles of lightning-protection, as presented, are in the main correct; and, as general principles, they deserve a wide dissemination. The particular system urged as the only efficient one is more complicated, and, even if it were not patented, more expensive than is necessary. Some novel statements are made, concerning what lightning 'will do' under certain circumstances, in the same paragraph in which the author bemoans the ignorance shown by scientific men on the subject of lightning-protection.

The author does not seem to be aware of the existence of what is doubtless the most complete and authoritative treatise on the subject yet published, — the elaborate 'Report of the lightning-rod conference,' edited by G. J. Symons, F.R.S. This conference was made up of delegates from the London meteorological society, the Royal institute of British architects, the London society of telegraph engineers and electricians, the London physical society, and two co-opted members, Profs. W. E. Ayrton and D. E. Hughes.

The examination of the various problems presented was exhaustive, and the code of rules for the erection of lightning-conductors published in the report is simple and easily understood. The proper construction of an efficient lightning-conductor is, after all, a matter of no great difficulty, and of comparatively little expense. The inauguration of a proper system of testing conductors would certainly reveal some astonishing facts in regard to the efficiency of rods as generally erected, elaborate and expensive as they often are. The wide circulation of the rules adopted by this conference would undoubtedly be the means of bringing about a much-needed reform in this direction.

COHN'S 'DIE PFLANZE.'

Die pflanze: Vorträge aus dem gebiete der botanik. Von Dr. FERDINAND COHN, professor an der Universität zu Breslau. Breslau, *Kern,* 1882. 8 + 512 p. 4°.

THIS elaborately gotten up book of over five hundred pages comes to us as a contribution to general literature, and does not address itself to the scientific botanist, except as he is interested in a popular presentation of botanical facts and problems with which he is supposed to be more or less familiar. Dr. Cohn believes it to be the duty of those versed in any branch of science to produce a literature which shall invite a large circle of readers to an interested acquaintance with their chosen science. "Nor are they to recoil from this task," says he, "because of the difficulties which present themselves for satisfactory solution, or because popular writings on natural science have been undervalued by many." Actuated by his conviction, Dr. Cohn has collected the addresses which he delivered at various places in Germany between the years 1852 and 1881, and, while retaining their original form, has remodelled them sufficiently to bring them up to date and compact them into a shapely whole.

In the preface the author sets forth a difficulty which besets the popular lecturer on scientific topics, — one which doubtless every one who has tried this style of address has fully realized,—namely, the meagre knowledge and hazy comprehension with which the majority of hearers listen to his words, necessitating so long a dwelling on the elementary facts of the topic that little time is left for the consideration of the more recondite and interesting points.

If we may be allowed to judge, Dr. Cohn has overcome this difficulty to a large degree in a very happy manner. He devotes the first lecture, entitled 'Botanical problems,' to a brief history of the development of botany, and an explanation of some of the elementary principles of the science, thus paving the way for subsequent discussion of more special matters. Some idea of the variety of the topics treated may be gained from the titles of the sixteen lectures, which are as follows: 'Botanical problems,' 'Goethe as a botanist,' 'The cell state,'

'Light and life,' 'The plant calendar,' 'From pole to equator,' 'From sea-level to eternal snow,' 'What the forest tells of itself,' 'Grapes and wine,' 'The rose,' 'Insectivorous plants,' 'Botanical studies on the seashore,' 'The world in a water-drop,' 'Bacteria,' 'Invisible enemies in the air,' 'Gardens in ancient and modern times.'

The lectures are written in an entertaining style, and vary in interest as little as the inequality of the subjects will allow. The two on 'Light and life' and 'The cell state' are especially happy, particularly the latter in an apt comparison of a plant to a state.

The design of the book is laudable, and its execution admirable. We commend both as models to our American biologists and physicists, who owe it to the American public to provide better opportunities for a general acquaintance with scientific problems and methods.

REPORT ON SORGHUM-SUGAR.

Investigation of the scientific and economic relations of the sorghum-sugar industry; being a report made in response to a request from the Hon. George B. Loring, U. S. commissioner of agriculture, by a committee of the National academy of sciences, November, 1882. Washington, *Government*, 1883. 152 p. 8°.

A PROBLEM, which, if not the most important, is certainly the most prominent, agricultural problem of the day, is that of the profitable production of sugar from sorghum. The experiments made during the last few years at the U. S. department of agriculture and elsewhere have attracted general attention, both on account of the interesting scientific questions involved, and still more because they promise to create a new branch of agricultural industry, and to greatly enlarge our domestic supply of sugar.

The report of the committee of the National academy on this subject must prove very valuable to all interested in the promotion of this infant industry, because it contains a very full summary, prepared by thoroughly competent and impartial persons, of all that has been accomplished in this direction up to the date of the report, and thus collects in one publication information previously scattered through numerous state and other reports. That the work has been well done is sufficiently guaranteed by the names of the committee. They were Prof. William H. Brewer, Ph. D., of the Sheffield scientific school; Prof. Charles F. Chandler, Ph.D., of Columbia college; Prof. S. W. Johnson, M. A., of the Sheffield scientific school; Prof. B. Silliman, M.A., M.D., of Yale college; Prof. J. Lawrence Smith, M.D., late of the University of Louisville; and also, not of the academy, Gideon E. Moore, Ph.D., of New York. Prof. C. A. Goessmann, of the Massachusetts agricultural college, was also a member of, and acted with, the committee until Sept. 15, 1882, when he resigned.

The committee begins its report with several pages of citations from earlier (chiefly American) investigations upon sorghum as a sugar producing plant, showing the conflicting opinions upon almost every essential point of the subject entertained by the authorities quoted. On such points as the kind of sugar present in the juice, the best varieties of sorghum, the proper time for harvesting and working, etc., diametrically opposite opinions, each by reputable authorities, are quoted.

This was the state of the question, when, in 1878, the U. S. department of agriculture, by its chemist, Dr. Peter Collier, began its well-known investigations, which went far to decide many of the points just spoken of. This work the committee does not review in detail, but contents itself with a favorable criticism of the analytical methods employed, and with pointing out the material value of the results and the need of further investigation.

At the time when this report was prepared, the successful work of the department of agriculture consisted chiefly of chemical examinations of sorghum-juice, attempts to produce sugar from it on a manufacturing scale having proved partial failures: the committee therefore closes its report with brief accounts of the results of practical attempts to make sugar from sorghum. Among these are noted two failures, and seventeen cases of more or less pronounced success, several on a manufacturing scale.

In an appendix are collected divers interesting papers bearing upon the subject of the report. Some of them present fuller details of experiments referred to in the report, and some contain accounts of later successes in sugar-production. This portion of the report concludes with a 'Bibliography of sorghum,' which cannot fail to be of great value to investigators in this field.

It is evident from the facts collected in this report, and from the experience since gained, that, with skill in working, sugar can be successfully made from sorghum. It is also equally evident, that, without that skill and the proper appliances, failure is more probable than success. Sirup can easily be made from sorghum on a domestic scale, but not sugar.

Finally this report makes very evident the need for further investigation in regard to such important points as the best varieties of cane, and the possibility of their improvement by selection and crossing, the most suitable soil for sorghum, the effect of fertilizers on its growth and content of sugar, the methods of extracting the sugar from the cane, and the prevention of losses in the further treatment of the juice. In a word, while sugar can be made from sorghum, it yet remains to be seen how economically it can be manufactured, and how completely the great waste involved in the present crude processes can be avoided; and the committee closes its report by urging upon the U. S. department of agriculture especially, the duty of continuing the investigations which have already yielded such important results.

HANN'S CLIMATOLOGY.

Handbuch der klimatologie. Von Dr. JULIUS HANN. Stuttgart, *J. Engelhorn*, 1883. (Bibliothek geographischer handbücher.) 10 + 764 p. 8°.

THERE are many treatises upon the subject of climate. The larger number of these are devoted to the consideration of the special characteristics of the climate of some particular country, and contain numerous statistics derived from meteorological observations, together with a description of the prevailing weather conditions. A few discuss the subject from a broader stand-point, and take account of the general conditions which prevail over a large area, with their causes and modifications. The treatise before us, however, differs from its predecessors in its aim as well as in its execution. It is designed to give a view of climatology as the result of certain forces which are at work in nature, and to investigate the result of the operations of these forces as they are exhibited in the climate of the world. Its author is the acknowledged head of meteorological science in Austria, — one who has done much to place meteorology on a scientific basis, and who is especially qualified to speak with authority upon the subjects which he treats, on account of his well-known familiarity with the current work of other investigators, and his ability as a critic. It is to be expected that a work written by such an author will be comprehensive, thorough, and masterly, that it will indicate the present condition of the subject from a scientific stand-point, and be as accurate as the best data at hand can make it. All these conditions are fulfilled and abundantly satisfied in the work before us.

The aim of the treatise is to present a comprehensive view of climatology. First the word is defined, its object specified, and the various climatic factors mentioned, briefly discussed, and illustrated. After this introduction, which is, in fact, a concise treatise upon the subject of climatic statistics rather than a simple introduction, the author proceeds to treat the subject in two divisions, — general and special climatology. Under the former head are considered, 1°, 'solar climate,' or that which would result directly from solar radiation; then, 2°, the modifications introduced by atmospheric and terrestrial conditions, resulting in climate as actually existent. Under the latter head are considered the special climatic characteristics of different portions of the globe, with copious illustrations. In carrying out this plan, the author treats the various topics with conciseness but with singular clearness, and advances in logical progression without dwelling too much on the minor details, or retarding the course of thought by discussing the many collateral subjects which are naturally suggested. In a few instances, where a controverted subject is discussed in the text, an elaborate footnote is devoted to a defence of the author's position, or a statement of the dissenting opinions of others; and several appendices contain fuller explanations of the special topics touched upon in the main portion of the treatise. In this way the author preserves the unity of the work, and at the same time calls attention to important considerations to which he cannot give much space in the body of the treatise. The work is not exhaustive: indeed, that would be impossible in so comprehensive a subject. In many cases it does not enter into the details of an investigation, but gives the results obtained without discussing the methods of investigation employed.

At the outset the author carefully defines the word 'climatology,' and shows the relation between climatology and meteorology. By climate is to be understood the average weather conditions of different places on the earth's surface, together with the extent of the deviations from the average conditions. The climatologist, in treating the causes of climate, necessarily makes use of the laws which the meteorologist in his broader study of atmospheric phenomena has deduced, and, in turn, furnishes the latter with facts which he must account for by the meteorological principles he has established. The two sciences are therefore intimately connected; and we may, if we wish, regard climatology as a part of the

science of meteorology, which takes into account the phenomena included in the latter only in so far as they affect the well-being of living creatures on the earth. It is well to establish a definite position for climatology; and the author is wise in restricting it to average weather conditions, and deviations from the average, for these are the controlling influences which determine the relations of any place to animal life. The important climatic factors are temperature, moisture, cloudiness, wind, atmospheric pressure, evaporation and the chemical composition of the air, mentioned nearly in the order of relative importance; temperature, rainfall, and wind being usually given as the three essential factors. These factors are not independent, and are so mutually connected (as, e.g., cloudiness and temperature) that they cannot be discussed separately. Atmospheric electricity is recognized as important, but needing further study before it can be classed as a factor. It would seem as if a similar reason would have prevented the insertion of the composition of the air in the list of factors; for the relation of the chemical constituents in their varying proportions to animal life is confessedly obscure. In the discussion of these factors, those special features with regard to each are mentioned which would be useful in representing statistically the climate of a place. Especial prominence is given to temperature statistics; and eight different subjects are named which deserve representation in tables, such as the monthly and annual means, magnitude of daily ranges, etc. An important omission in the tables usually given is pointed out; viz., some expression for the rapidity of temperature changes. The author suggests two ways in which this can be done, — 1°, by the difference between consecutive daily means, and, 2°, by the rapidity of changes in some adopted period of time. These and other suggestions can be profitably considered by those who have charge of the preparation of weather statistics: they should be presented in such a shape as to enable any one to readily obtain the facts as to the climate of any place for which he consults them. The statistics of Vienna are presented in illustration of the subject.

The section devoted to general climatology is of special value. Quite properly, it begins with a discussion of climate as dependent upon the distribution of solar heat, and thus includes the results of investigations in solar radiation. Disregarding for the time the effect of the atmosphere, the distribution of solar heat is treated as dependent upon the sun's altitude, the length of the day, and the distance between the earth and the sun. The combined effect of these elements is seen in different latitudes and in the two hemispheres, and is the basis of actual climate. The effect of the atmosphere in modifying these results is next considered, and the subjects of atmospheric absorption, diffusion, and reflection treated. For the sake of comparison, the relative effects on light, heat, and chemical power, are considered, though that relating to heat alone properly comes into consideration. The little knowledge which we possess on these subjects is the cause of the somewhat meagre presentation which the author gives. Coming finally to the further modifications in the distribution of solar heat due to the earth itself, the characteristics of insular, continental, and mountain climate are pointed out, and the effect of marine and aerial currents noted. In this way the author arrives at the actual climate which prevails over the earth, having started with its prime source, the sun. The discussion throughout is general, but is very suggestive of further study by the reader, in the different topics treated. The author quotes extensively from the works of others, and gives copious illustrations. It would be a great help to the student, however, if, as has been elsewhere suggested, references to the works themselves were given, in addition to the names of the authors, which are always carefully mentioned. This section could be expanded into a larger treatise, and may serve with advantage as the basis of extended research, or as a help to class instruction.

The section devoted to special climatology occupies two-thirds of the whole work. After an introduction upon the division of the earth into climatic zones, the author considers the observed climate in each zone, quoting extensively from the publications which describe the prevailing conditions in each country, giving numerous tables, and summing up under each zone its general characteristics. In this section we have, therefore, a compendium of accessible statistics covering the whole world, given in as much detail as the generous limits of the work will allow, and combined with carefully prepared summaries. In order to judge of the excellence of this section, it is only necessary to note how thoroughly the different countries are treated, whether the selections made for illustration are typical or not, and whether the author has made use of the most reliable publications. In all these respects it will be found that the work before us excels. Thus, in describing the climate of North America, the author first gives a statement of

the topography of the country, and the important distinctions in climate which result therefrom; then, passing to the climatic factors, he describes in detail the temperature, rainfall, humidity, cloudiness, pressure, and winds as they exist in the different sections, and illustrates principally from the publications of Schott, Woeikoff, Blodgett, Loomis, Coffin, Dall, Gannett, Whitney, and the signal-service. Not content with general characteristics, he further specifies peculiarities, such as the suddenness of temperature changes in certain localities, tornadoes, northers, and Indian summer, with appropriate quotations from various writers; and he also appends special descriptions of the climate of Illinois, Lake Superior, the Mississippi valley, Canada, Manitoba, Hudson's Bay, Alaska, the plateau region, Colorado, California, Arizona, and the Bermudas. The climate conditions of other countries are treated with similar thoroughness, making the whole valuable for reference, while its chief merit lies in the running descriptions and summaries. A defect in the work is the lack of charts illustrating the various data. A few only are given; the main reliance for illustration being in the statistical tables, which are almost unnecessarily abundant. Graphic representations are always specially valuable to the reader, and their addition to the work would be a real improvement. It would also have been well to mention the analytical method of representing data, as well as the statistical and graphical; for, while its use is limited, it will surely grow in favor with the advance of the science.

The work of Dr. Hann represents the latest investigations, and is brought down almost to the very date of publication. It will therefore not be soon superseded; and, while additional data will accumulate in coming years, the general discussions will require but little alteration. The work is recommended for the general reader, not to be read in course, but by proper selection. The general chapters and the summaries contain a large amount of information, for which the details and illustrations can be obtained from the accompanying pages. The student will find the work useful in calling attention to the authorities in each subject. Especially in the section on general climatology, where such topics as solar radiation and atmospheric absorption are, from the design of the work, treated in a general way only, will be found quotations from the publications of the latest investigators. It would be well, too, if the treatment of the subject of climatic factors should call attention to the need of publishing statistics in such a way as to be useful for reference. In this country particularly, we need to give consideration to this subject. There is scarcely an allusion made in the work under review to recent meteorological work in the United States, not because it has not been published, but because it has not been issued in a suitable form. In order to compare our statistics with those of other countries, it is necessary first to re-arrange and classify them. The international meteorological committee has recommended forms of publication, the adoption of which will add greatly to the facility with which corresponding data can be compared. But even these forms do not give all the data which the climatologist would like to have; and meteorological observations could be made more available for studies in climate by attention to the author's treatment of the subject. There is also need of deducing more results from the immense collection of data which is daily accumulating all over the world, to check the prevailing tendency of heaping up observations for no useful purpose. If this work shall have the effect of stimulating research, and promoting a more intelligent use of meteorological observations, it will do much good. It is to be hoped that it will be translated into English to reach a wider circle of readers.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Ottawa field-naturalists' club, Canada.

Jan. 31. — Mr. W. L. Scott read the report of the ornithological and oölogical branch, showing that a number of rare birds had been secured, that thirteen species had been added to the published lists, and that other good work had been done. Among specimens exhibited was a great white egret, in full breeding-plumage, which had been shot on the Upper Ottawa, — a locality far north of its usual range, but where it is stated to be a not uncommon visitor. Its name, however, will not appear in the lists of the club, as the locality is considered beyond the limits of its district.

Prof. J. Macoun read a practical paper on the 'Edible and poisonous fungi' of the vicinity. He pointed out, that while at present the only fungus collected for food is the common mushroom, Agaricus campestris, there are other equally nutritious and palatable forms which exist in far greater abundance; as, for instance, Coprinus comatus, which grows in great profusion about the city during Sep-

tember. Two species of morel, Morchella esculenta and Gyromitra esculenta, are also common, and are very desirable food-supplies; while the Lycoperdons, or puff-balls, are found in immense numbers, and often of large dimensions, and, when young, are excellent for the table. Among poisonous forms, the fly-agaric, Amanita muscaria, was instanced as one of the most highly organized, most widely distributed, most beautiful, and most dangerous of the agarics. The difficulty of distinguishing by sight between many edible and non-edible or poisonous species was stated; and it was explained that those having a pleasant odor and taste were always likely to be eatable and harmless, while others would be more or less injurious. It is, however, always advisable, at first, to eat but a small quantity of any untried species. Professor Macoun, as botanist to the Geological survey, is now working at the fungi of Canada, and is preparing a report thereon for publication. Beautiful plates to illustrate this report have been drawn by Mrs. Chamberlin, a member of the club; and such as related to the forms discussed were exhibited by her, to the great gratification of the members. — The secretary laid on the table advance copies of the Transactions of the club for 1882–83, and announced that they would be ready for distribution in a few days.

Princeton science club.

Jan. 25. — Professor Rockwood gave a paper on the mutual relations of the conics, discussing especially the changes by which the different curves turn one into another through their limiting forms. He traced the various curves represented by the equation $A^2y^2 + B^2x^2 = A^2B^2$, when A^2 is constant, and B^2 assumes all possible values, showing them to include all the varieties of the ellipse and hyperbola. In the same way the equation $y^2 = \frac{2B^2}{A}x - \frac{B^2}{A^2}x^2$ was shown to include *all* forms of the conic when A and B assume various values, — zero, infinite, or finite. In tracing the movement of the foci, he showed that in the series of ellipses and hyperbolas the foci come first to coincide at the centre; afterward their distance from the centre becomes $c\sqrt{-1}$, which, by interpreting the imaginary factor as indicating revolution through a right angle, changes the foci from the horizontal to the vertical axis, on which they then recede to infinity, returning from infinity on the horizontal axis when the ellipses change through two parallels to the series of hyperbolas. The changes were also followed out with focus and directrix fixed and eccentricity varying, with focus and focal ordinate fixed and eccentricity varying, etc.

Professor Scott reported that he had just discovered a rudimentary pollex in Oreodon of the White River miocene. The carpus is very primitive in arrangement, and a trapezium is present.

New-York academy of sciences.

Jan. 21. — Two specimens of corundum from western North Carolina were exhibited by G. F. Kunz. One was a crystal weighing 13 grams: the other, weighing $3\frac{5}{16}$ carats, was cut *en cabachon*, and by the exhibiter was said to be the most perfect star-sapphire probably yet found in the United States. Both pieces were a rich light-brown color, very compact, and resembled a variety of sapphire from the hills of precious stones in Siam. Prof. H. L. Fairchild delivered a lecture on methods of animal self-defence, which was well illustrated with a large series of well-selected lantern-slides. Remarks were made by President Newberry and Prof. W. P. Trowbridge.

Canadian institute, Toronto.

Jan. 19. — Prof. R. Ramsay Wright gave an account of researches on the skin and nervous system of Amiurus catus, which will shortly be published in the Proceedings. Special attention was devoted to the 'clavate' cells of the epidermis, to the branching of the fifth nerve, and to the relationship between the air-bladder and auditory organ.

Natural science association of Staten Island, New Brighton.

Jan. 12. — Mr. C. W. Leng read a paper on the Cicindelidae of Staten Island. The beetles live all summer in sunny places in the woods, roadsides, and on the sands at the seashore. They are able to make short flights, which they do at the least alarm, flying a few paces at a foot or two from the ground, and then dropping quite suddenly. Their colors always mimic the places at which they are found, which makes it difficult to distinguish them after they alight. During the night and rainy days they hide in holes dug in the sand, or among piles of chips and bark. The following eight species have been found on Staten Island: C. sexguttata, purpurea, generosa, tranquebarica, repanda, hirticollis, dorsalis, punctulata.

Remarks were made by Mr. Sechusen on a very interesting series of precious stones, their particular characters, and the localities from which they came.

Society of arts, Massachusetts institute of technology.

Jan. 10. — Dr. Charles S. Minot, of the Harvard medical school, read a paper giving an account of his researches on growth and death. Dr. Minot has undertaken an extensive series of experiments, which will occupy many years, on senescence, or the process of growing old; and he presented in this paper the results of one branch of his investigations, in which he had studied the growth of the guinea-pig from birth until the attainment of the full size, having made about fifty-five hundred weighings of these animals, the weight being the function of growth best adapted for study.

In 151 recorded births, the proportion of males to females was found to be 119 to 100. The average weight at birth was about 72.5 grams, and was about the same for males and females. The range was from 42 to 99 for the males, and 46 to 111 for the females. The most potent influence on the weight at birth was found to be the number in a litter; the larger the litter, the less the average weight. The period of gestation was found to average 67 days; and the longer the period, the greater the weight at birth

This weight was also greater in summer than in winter. Notwithstanding the great variation of weight at birth, the difference diminished with age, all the animals thus tending to approach a certain standard size. One of the most important facts discovered was, that the rate of growth diminishes continuously from the time when the animal recovers from the loss of weight at birth; this diminution being rapid at first, and slower afterward. By rate is here meant, not the absolute increment in weight in a given period, but the per cent of the weight at the beginning of the period, which is added to said initial weight during the period. A discussion of the best available data indicates the result to be also true of man.

Dr. Minot had also made some experiments with rabbits, and compared the results with those for guinea-pigs and for man. He found that the guinea-pig grows on an average, until it is full-grown, 1.73 grams per diem, the rabbit 6.20, and man 6.60 grams. Men are therefore larger than rabbits, not because they grow faster, but because they grow longer; while rabbits are larger than guinea-pigs because they grow faster. The *rate* of growth, however, as above defined, is very different; being 4.6 % in the guinea-pig, 5 % in the rabbit, and 0.02 % in man.

Philosophical society of Washington.

Jan. 5. — Prof. J. R. Eastman discussed the Rochester (Minn.) tornado of Aug. 21, 1883, describing the ground as it appeared a few days after the storm, and showing that the phenomena did not indicate cyclonic motion. All disturbed objects were thrown in essentially the same direction, and were pressed down rather than lifted. In the course of the ensuing discussion, Mr. W. H. Dall described similar phenomena in the Escanaba region, where he observed storm-tracks consisting of swathes of prostrate trees, the trunks of which pointed uniformly in one direction.

Mr. Dall then read a paper on Recent advances in our knowledge of the limpets, summarizing the researches of Spengel on the sensory organs or osphradia; Cunningham, on the renal organ and renopericardial pore in Patella and Patina; Fraissé, on the eye in Patina, Fissurella, and Haliotis; and the speaker, on the presence of an intromittent male organ in Cocculina. He stated that among the Acmaeidae and Patellidae the type of eye differs; and while in Patina it is of a very rudimentary character, in other genera it might be well developed, — as, for instance, in Ancistromesus, which has as well developed eyes as Fissurella. He also alluded to the gradual progress in classification afforded by anatomical investigation during the past few years, and observed that nearly all the known forms except Propilidium and Scutellina were amenable to classification; our ignorance of the branchiae in the former, and the dentition in the latter, operating to prevent a final classification in these two cases until more is known. Those authors who study the embryology and histology usually from a single species generally ignore the wide differences of adult anatomy between the genera of limpets, and sow their generalizations on a basis of classification which is little in advance of that of Lamarck and his immediate successors.

The president of the society, Dr. James C. Welling, announced the death, since the last meeting, of Gen. A. A. Humphreys, one of the founders of the society, and pronounced a brief eulogy on his character.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Geological notes. — Prof. I. C. Chamberlin and his assistants, during December, 1883, were engaged in field-work in Illinois and in Missouri. Professor Chamberlin devoted his personal attention mainly to the borders of the newer drift, the concentric morainic belts that lie within it, and the contiguous old drift without it, in north-eastern Illinois. Mr. R. R. Salisbury continued his previous observations of the residuary clays and loess and drift-borders in eastern and central Missouri.

The revision of the manuscript of a report by Mr. J. S. Curtis on the Eureka mines has been completed by Mr. G. F. Becker and Mr. Curtis, and will soon be ready for the printer.

Since the beginning of Prof. R. D. Irving's study of the metamorphic rocks in 1882, he and his assistants have made five hundred thin rock-sections. Of this number, written descriptions of three hundred have been prepared. They include rocks from the original Huronian, the Huronian of the Marquette and Menominee regions, the Animikie group of the national boundary, the folded schists of the same region, and the crystalline rocks of the Minnesota and Mississippi valleys.

Assistant John Chaplin at Denver has prepared thin sections of all the eruptive rocks collected in the Rocky-mountain district during the past season.

Paleontology. — Prof. L. F. Ward has completed the work of preparing index slips for a catalogue of fossil plants. He has so arranged all of the fossil plants collected from the Laramie and Fort Union groups, that they are in a convenient form for future detailed investigation.

Chemical division. — The analyses of waters from Walker Lake and Walker River have been completed by Prof. F. W. Clarke.

Mr. J. W. McGee, in his examination of the subterranean forest exposed by an excavation on Connecticut Avenue, Washington, D.C. (referred to in *Science* of Nov. 30, 1883), discovered an earthy blue mineral, which was abundantly distributed throughout the

stratum of clay, at the bottom of which the remains of wood were found. This blue earthy mineral has been identified as vivianite by Professor Clarke.

Mr. Hillebrand, in the laboratory at Denver, has been examining the Leadville porphyries with respect to the proportion of precious metals contained in them. He has prepared a new gravity-solution, the borotungstate of cadmium, designed to replace in part the Thoulet solution, which is in some cases inapplicable in the separation of the mineral constituents of rocks. He has also made various qualitative examinations of several minerals new to the west, — tantalates, columbates, and phosphates of rare earths.

Dr. Mellville and Mr. G. F. Becker, at San Francisco, have been investigating some of the chemical relations of quicksilver.

In the laboratory at New Haven, Dr. William Hallock, at the suggestion of Mr. Arnold Hague, has begun a series of experiments upon the artificial production of geysers. Small models have been made that worked admirably with regular periods. An artificial geyser, with a reservoir twenty-five feet deep, has been constructed, and will soon be in working-order. The study of this model will be of exceeding interest.

Topographical notes. — It was hoped that topographical work could be carried on through the winter in Massachusetts; but owing to the continued bad weather through December, especially in the latter part of the month, the work was greatly delayed; and about the middle of the month it was decided to postpone further field-work in the state until spring.

Mr. Willard D. Johnson, assistant topographer, who has been preparing several small local maps in the Mono basin, California, has completed a map of the Parker-creek moraines, and began one of the Leevining-creek moraines. He has been unable to complete the latter on account of unfavorable weather. The map of the Parker creek moraines includes an area of about seventeen square miles, on a scale of four inches to the mile. The general map of the Mono basin covers some two thousand square miles, and the field sheets of the map are upon an approximate scale of one inch to one and three quarters miles. Several points of the transcontinental triangulation of the coast and geodetic survey are included. They give it scale and position. The vertical relief is derived mainly from angles, and a line of levels connects the work with a determined point on the Carson and Colorado railroad. The map exhibits the outline of the ancient expansion of Mono Lake; the outlines of the ancient ice-stream of the adjacent Sierras with their present remnants. Agricultural and grazing lands are shown, and the areas of timber lines also indicated.

Mr. J. D. Hoffmann, in the division of the Pacific, was busy during December, carrying on the detailed survey of the new Idria quicksilver district in California.

Prof. A. H. Thompson, geographer, was occupied during December in the determination of the latitude and longitude of Fort Wingate, New Mexico, which work has been satisfactorily completed.

PUBLIC AND PRIVATE INSTITUTIONS.

Harvard college observatory.

Funds. — In his report to the president of the university, the director of the observatory states that the annual subscription of five thousand dollars, which has been in force for five years, has expired by limitation, and that an attempt to raise a fund of one hundred thousand is meeting with good success, about half having been already obtained.

Variable stars. — The study of the variable stars has been continued by Mr. Chandler. The bibliography is nearly completed, so far as the first extraction of references is concerned. Notes have been prepared to exhibit the evidence of variability which has been published with regard to about twelve hundred stars. This list excludes many cases in which the evidence is entirely inadequate. A table, giving all the published maxima and minima of each of the variables of long period, is now in process of construction. The preparation of this table has led to the important result that an interval of several years occurs in which no observations appear to have been made of about thirty of these objects. About one hundred and forty stars belong to this class; and, since last April, all of them have been observed by Mr. Chandler with the six-inch Clacey equatorial mounted in the west dome. Charts of the vicinity of these variables have been prepared, and some progress made towards their completion. Similar charts have been made for about seventy telescopic stars suspected of variability, and nearly two hundred observations of these stars have been obtained. The color of the variable stars is also estimated, about three hundred observations of this class having already been made. The circular distributed, asking the aid of amateurs and others, in the observation of stars known or suspected to be variable, has, it is believed, secured much valuable co-operation. Numerous replies have been received, and important results have been obtained, especially by Mr. H. M. Parkhurst of New York, and by the Rev. J. Hagen, S.J., of Prairie du Chien, Wis. The great difficulty encountered by most of the observers was that of identifying with certainty the fainter stars, although this is one of the first things that should be learned by any person desiring to do useful astronomical work.

Astronomical photography. — With the assistance of Mr. W. H. Pickering, an investigation was undertaken in astronomical photography. Two objects were kept in view, — first, the determination of the light and color of the brighter stars; and, secondly, the construction of a photographic map of the whole heavens. After numerous preliminary observations, a method was employed by which a photograph of the brighter stars included in about one-twelfth of the entire heavens could be obtained on a single plate. Maps were also obtained, containing a region of about fifteen degrees square, containing stars as faint as the eighth magnitude. The color exercised a marked influence on the intensity of the photographic images, in some cases producing a difference equivalent to four magnitudes. It is thought that

photography may offer the most delicate test we yet have of the color of a star, — differences too small to be perceptible by the eye, becoming distinctly visible in the photographic images.

NOTES AND NEWS.

PROFESSOR MILNE-EDWARDS writes to the Société de géographie in regard to the scientific work of the expedition on the Talisman. After having studied the profiles from the African coast into deep water, the vessel recruited at San Jago, Cape Verde Islands, and later at San Vincente; soundings being carried on during the various movements of the vessel, and proving of great interest, as in some cases they did not accord with those on the charts. Branco Island, which has never been visited by naturalists, was carefully explored. The shores are very rocky, and it became necessary to swim ashore, which the temperature rendered rather agreeable. The island is entirely volcanic, and the rocks of a singular nature. Those near the shore were blocks of lava cemented by a sort of calcareous coquina, containing many shells, into a kind of pudding-stone. Others consisted of sea-sand, drifted by the winds to an altitude sometimes of a thousand feet, and changed into solid layers by calcareous infiltration. Vegetation is very sparse, yet the great lizards peculiar to this island were found to be herbivorous. The Sargasso Sea was then examined, and proved to be of great depth, reaching nearly thirty-three hundred fathoms, and the bottom entirely volcanic, with a rather poor fauna. A collection of lava and scoriae was obtained, some of which appeared to be of quite recent origin. There is probably in the Atlantic an immense band of volcanoes extending parallel with the Andean system, perhaps to Iceland, and of which the culminating peaks form the Cape Verde, Canary, and Azores islands.

More than two hundred deep-sea soundings were made before the return of the expedition *viâ* San Miguel, Azores. Wonderfully rich collections were made, and specimens of the bottom throughout the whole region traversed. The topography of the ocean-bottom hitherto accepted will be considerably modified by these researches. It was expected that Professor Milne-Edwards would address the society on the general results of the work before a general session about Jan. 21, and exhibit at the same time some of the treasures obtained.

— At the meeting of the Paris academy of sciences, Dec. 10, Dr. Hyades gave a summary report on the geological, botanical, zoölogical, and anthropological work accomplished by the French mission to Cape Horn. In the southern islands of the Fuegian Archipelago the prevailing rocks were found to be schists and granites, greatly weathered wherever unprotected by vegetation. The dwarf Antarctic beech is limited to an altitude of four hundred metres, the Fagus betuloides to three hundred, forming with the Drimys and Berberis a forest zone with a humid soil poor in vegetable humus, and covered with mosses, heaths, and a considerable variety of small plants. The marine flora abounds in all kinds of algae (the most common being the Macrocystis pyrifera), affording a shelter to numerous zoophytes, annelids, mollusks, crustaceans, and migratory fishes of eight or ten species. Of the shell-fish, which abound on most of the seaboard, all the large species are edible. Although poorer than the marine, the land fauna includes several species of Coleoptera, Lepidoptera, Arachnida, some forty species of birds, but no reptiles or frogs. The mammals are represented by only one species of fox, two rodents, and an otter, besides the domestic dog. The natives all belong to the Tekeenika stock of Fitzroy, called Yahgans by the present English missionaries. They speak an agglutinating language, current from the middle of Beagle passage to the southernmost islands about Cape Horn. About one thousand words of this language were collected, including some abstract terms, such as *tree*, *flower*, *fish*, *shell*. The numerals get no farther than three, although the natives count also on the fingers. Over a hundred anthropometric observations were taken on individuals of all ages and both sexes. Good photographs were also obtained of a large number of Fuegians, besides numerous castings of all parts of the body, some skeletons, and a great variety of ethnological materials.

— Besides the analyses of snow made at Madrid and in Holland (in which was observed volcanic sediment similar to that of the ashes found in Java after the eruption of the volcano), mentioned by Mr. Upton in his article on the 'Red skies,' in *Science* of Jan. 11, *Nature* of Dec. 20–Jan. 3 contains a number of letters in which mention is made of a grayish volcanic (?) sediment having been found at several points in England after rain-storms in December.

— The International congress of geologists will meet at Berlin on the 25th of September next, and last five days; then a grand geological excursion will be made through the Hartz Mountains, Saxon Switzerland, from the 1st of October to the 5th, ending at Dresden by a visit to the Royal museum, under the guidance of its celebrated director, Prof. Dr. H. B. Geinitz.

— In Oregon City there is a large apple-tree in the Methodist-church lot, planted in 1842 by W. S. Moss, Esq., for Rev. G. Hines, who was then living there. The tree bears two kinds of fruit, but only one kind each year, and the different kinds appear on alternate years. It is still a vigorous, healthy tree.

— It is understood that the outer satellite of Mars, Deinos, has been observed by Professor Hall during the present opposition. As the planet Mars is now near its aphelion, its visibility would seem to show that the satellite can be observed at every opposition of Mars with the great telescopes which have recently been constructed.

— The Pi eta scientific society of Troy, N.Y., has changed its name to Rensselaer society of engineers.

SCIENCE.

FRIDAY, FEBRUARY 15, 1884.

COMMENT AND CRITICISM.

It may not be generally known that it is the duty of the National academy of sciences to examine and report upon such matters as may be submitted to it by the proper authorities of the national government. The problem is referred by the academy to a committee, composed of such of its members as are specially skilled in the science to which the subject appertains; and they consider it in the light of all accessible data, and, where necessary, submit the problem to experimental investigation and study. It is not unusual, also, to call into council experts in good standing who are not members of the academy. All these services are rendered gratuitously, only the actual expenses incurred being defrayed. It would seem as if no fairer way could be devised for obtaining an honest and intelligent opinion on the question at issue; since the government is unbiassed, and the jury untramelled, while it consists of men whose ability and attainments are guaranteed.

Many reports have thus been presented to the government during the existence of the academy; but few seem to have attracted as much attention, or to have aroused as much feeling, as a recent report made to the commissioner of internal revenue upon the question as to the wholesomeness of glucose as an article of food. The conclusions reached are, 1°, that the manufacture of sugar from starch is a long-established industry, scientifically valuable and commercially important; 2°, that the processes which it employs at the present time are unobjectionable in their character, and leave the product uncontaminated; 3°, that the starch-sugar thus made and sent into commerce is of exceptionable purity and uniformity of composition, and contains no injurious substances; and, 4°, that though having at best only about two-thirds the sweetening-power of cane-sugar, yet starch-sugar is in no way inferior to cane-sugar in healthfulness; there being no evidence before the committee, that maize starch-sugar, either in its normal condition or fermented, has any deleterious effect upon the system, even when taken in large quantities.

For reporting these conclusions, the members of the committee have been most severely attacked, and their honesty impugned. One of the most bitter and partisan of these attacks is contained in a recent 'leader' in the Washington *Evening star*, in which it is distinctly implied that this report favors the use of glucose in adulteration. Inspection of the report shows this deduction to be entirely without foundation; and the attack reveals the most unpardonable ignorance, or a deliberate intention to deceive. The use of glucose in adulteration is a well-known fact, and it is the duty of the commercial and legal fraternities to devise means for its prevention. The wholesomeness of glucose was a matter about which nothing was definitely known, and the fact of its being largely used in food made the matter of the gravest consequence. The consideration of this fact was the most important duty of the committee.

The action of the New-England fish and game convention, recently assembled in Boston, should meet with cordial support in all quarters. The object of the convention was to secure uniformity in the fish and game laws of all the New-England states, and to see that these laws are so worded that they may be enforced. The present game laws, of Massachusetts at least, are in great measure a farce, as under them convictions are often impossible, even when infringement of the law is clearly proved. This is due, in part, to the varying close times in different states, — a condition of things which encourages the smuggling of ille-

gally acquired game into a neighboring state. A carefully considered draught of the proposed uniform laws has been presented to the Massachusetts legislature; and since it would be difficult to find, in all New England, persons more competent to draught such laws than those who recently came together for this purpose, it is hoped that the draught, without material change, will be accepted by the legislature. Provision is made for the granting of special licenses only to actual students, cutting off the nearly indiscriminate license-giving to young men who wish to form collections for their personal gratification, and not for true scientific study. The lobster question has become far more serious than most persons are aware. This important crustacean is now nearly extinct on our shores; so that the proposed close time, and the prohibition of the capture and sale of any lobster under one foot in length, are wise additions to the existing laws. The proposal to intrust the duties of game commissioners to the commissioners on inland fisheries, as is done in some states, is another important provision of the proposed law.

The movement which within the last few years has caused a rapid organization of agricultural experiment-stations in various parts of the United States has developed another phase of the problem concerning the distribution of work in botanical research. The very marked development of botanical science within the last ten or fifteen years has necessitated specialization in several directions, and renders it necessary to consider which of the particular fields inviting research should remain identified with our higher institutions of learning. One of the most promising fields at the present time is to be found in vegetable physiology; but this is discovered to be naturally gravitating towards the experiment-stations and away from the colleges. This is a phase of the problem which should be carefully considered by those who have in hand the interests both of the science and of the stations; and care should be taken not only that those who are called to the charge of these important institutions should be capable of fully appreciating the importance of the interests involved in this particular branch, but that they should secure to it a position commensurate with its high character and the great possibilities which it offers in the way of practical results.

The present season is remarkable for the brilliancy of the evening sky; the four brightest planets, Venus, Mars, Jupiter, and Saturn, being all above the horizon at once. To add to the brilliancy of the spectacle, this takes place at a time when Orion, Taurus, and others of the brightest constellations, are near the meridian, and nine stars of the first magnitude above the horizon. An additional point of interest to possessors of telescopes is, that Saturn is approaching both his perihelion and the point of greatest opening of his rings, and is therefore in that part of his orbit most favorable for study. About the middle of April an addition will be made by the simultaneous appearance of Uranus, Neptune, and Mercury, so that all eight of the major planets will be visible at the same moment. Of course a telescope will be required to see Uranus and Neptune, but the six others will be visible to the naked eye.

England has been rejoicing in a piece of elephant worship since Mr. Barnum placed at the zoölogical gardens in London the white elephant which he recently procured from Burmah. The natives of the east affirm, and the Europeans are willing to corroborate their statements, that the body of a dead elephant, except of such as die by the rifle, is never found. Whether they never die, or betake themselves to some remote body of water before they depart this life, is a disputed point. The great esteem in which the elephant is held is said to be due to the last incarnation of Gautama, before he was born as Buddha, being that of an elephant; yet, as the Buddhists' idea of the path of beings is on through at least seven heavens to the final total annihilation, it is not perfectly clear why they should not suppose the soul to finally take refuge in an old elephant, to rest with it in its unknown grave.

LETTERS TO THE EDITOR.

Deafness in white cats.

I AM engaged upon an investigation concerning the causes of deafness; and I have therefore naturally been much interested in Mr Lawson Tait's paper concerning deafness in white cats, published in *Nature* (vol. xxix. p. 164), and in the letter of Mr. Joseph Stevens, published in the same journal, concerning his father's breed of deaf white cats (vol. xxix. p. 237).

I have myself come across three instances of white cats with blue eyes (two in Europe and one in America), and in each case the animal was deaf.

Mr. Tait's statement, that "congenital deafness is not known to occur in any animal but the cat" is a most extraordinary one, in view of the great prevalence of congenital deafness among human beings.

Of the 33,878 deaf-mutes in the United States, more than one-half are congenitally deaf;[1] and in Europe (excepting Germany) the proportion of congenitally deaf appears to be much greater, — about four to one, according to the late Dr. Harvey L. Peet (1854).[2]

Why should congenital deafness among the lower animals be confined to cats, and why only to white cats?

Mr. Tait notes also an apparent association between epilepsy and whiteness in animals. He says, "Every kind of white animal I have kept as a pet has been the subject of epilepsy; and the association is suggestive when we are told, as I have been frequently, that the disease is unknown among negroes."

It is worthy of note, that deafness also appears to be less common among negroes than among white people. According to the recent census, the total white population of this country amounts to 43,402,970, and the total number of white deaf-mutes is 30,661. The colored population is given as 6,580,793, with 3,177 colored deaf-mutes (not including Chinese and Indians).

Thus, while we have one deaf-mute for every 1,416 of the white population, we have only one deaf-mute for every 2,070 of the colored people. It would be interesting to know whether the proportion of congenitally deaf is less among the colored than the white deaf-mutes.

The pallid complexion of many deaf-mutes has often been commented upon by strangers as an apparent indication of ill health. While I cannot say that I have myself observed this as a common characteristic, still my attention has never been specifically called to the point. It would be easy to test the matter by collecting into one room all the congenitally deaf pupils of some large institution, excluding those pupils who became deaf from accidental causes. A cursory examination would probably show whether there is or is not, in the human race, an association between congenital deafness and the absence of coloring-matter from the skin and hair. I trust that some of your readers may be able to throw light upon these points.

ALEXANDER GRAHAM BELL.

Washington, D.C., Feb. 4, 1884.

[1] See Compendium of the tenth census (1880), part ii. p. 1664.
[2] See American annals of the deaf and dumb, vol. vi. p. 237.

Radiant heat.

In a letter to *Science* of Jan. 25, Mr. Fitzgerald thinks it is possible that I am misled as to the manner in which my rotating-screens work, by reason of the complication of the arrangement. I must nevertheless continue to assert, that I think I understand how the process I have invented operates, and cannot admit that I am in error in this until such error is pointed out. Now, Mr. Fitzgerald's demand that I should show that the heat which originally came from B is returned to B *in the same direction* as the heat coming from A, would incorrectly lead the reader to suppose that I made some such statement or supposition in the original paper, and that consequently I was misled, as he suggests. But the most superficial examination of the paper shows that I have not for a moment supposed this; as I have simply proposed to so arrange the reflecting surfaces as to return radiations from B through some one or more of the apertures in the screen b, and not necessarily through the apertures from which they originated. It necessarily follows, that I did not suppose them to be returned in a direction parallel to the radiations from A.

I think, then, that Mr. Fitzgerald must certainly admit that I have not made the blunder which is implied in his letter.

Again: Mr. Fitzgerald takes it for granted, apparently, that this want of coincidence in direction would be fatal to the process; whereas, in my estimation, the only question is, whether the radiations which originally came from B are returned to B or not. What their direction may be appears to me entirely immaterial.

If it is possible to show that the want of coincidence in the direction of all the rays coming to B invalidates the process, as Mr. Fitzgerald implies, he will no doubt be able to give a direct proof of the fact. Such proof, however, seems to me impossible; for, after the energy reaches B, the path by which it has arrived is of no consequence.

It goes without saying, that in this view of the matter it is quite impossible to substitute the process proposed by Mr. Fitzgerald in place of mine; as in his process these directions necessarily coincide, which in mine cannot coincide.

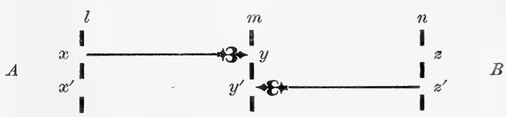


FIG. 1.

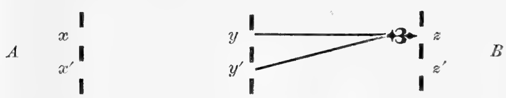


FIG. 2.

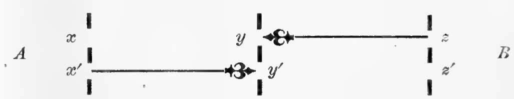


FIG. 3.

FIG. 4.

It does seem possible, however, to employ two sets of openings such as Mr. Fitzgerald has proposed, in such a way that they shall together accomplish what neither of them can effect singly. For example: let there be three fixed screens, l, m, n, with two sets of openings, $x\ y\ z$, $x'\ y'\ z'$, which can be opened or closed instantly; and let them all be closed except when the contrary is explicitly stated. Let each of the four equal intervals of time which we shall speak

of be the time required by the front of a ray in moving from n to m, or *vice versa*. During the first interval let x and z' alone be open. The rays between the screens at the conclusion of the first interval are shown in the first diagram. During the second interval let y alone be open, and let the reflector at y' send the ray impinging on it towards z. The situation of the rays at the end of the second interval are shown in the second diagram. During the third interval let x' and z alone be open. The rays between the screens at the end of this interval are represented in the third diagram. During the fourth interval let y' alone be open, and let the reflector at y send the ray from that point toward z'. The next interval is a repetition of the first, and so on.

It is seen that, in fact, the difference in the directions of the two rays arriving at B can be made less than any assigned finite angle, however small, by sufficiently increasing the distance between the screens, or sufficiently decreasing the space between the openings, or both.

It is possible that the above process may, from its comparative simplicity, conduce to a clearer understanding of the relations involved, though it seems inferior to the one originally proposed in some important particulars. H. T. EDDY.

University of Cincinnati, Feb. 2, 1884.

The Greely relief expedition.

In view of the comment upon the Greely relief expedition, it may not be out of place at this early date to call attention to a neglected principle of arctic navigation which bears with full force upon the navigation of the route in question. To its adoption may be traced the success of Nares with the Alert and Discovery, and of Nordenskiöld with the Vega; to its neglect, the wreck of the Jeannette and the Proteus among a host of others.

Simply stated, it is, under all circumstances, to cling to the coast, and among its islands find protection against the floating ice. To coast along the edge of the floe, and follow the openings it offers, is a veritable siren. Of course, the principle is not applicable till after Jones's Sound is passed; but here the course is usually free.

The Eskimo knew me as TILITOIANIAC.

New Haven, Conn., Feb. 2.

The red skies.

I have only time to-day to reply very briefly to your editorial inquiry on p. 30, as to previous instances of red skies and volcanic eruptions.

You will find a West India instance in 1831 on p. 165 of the *Meteorological magazine* for 1883; but the most striking parallel has been pointed out by Professor Karsten of Kiel as occurring in 1783, lasting about four months, and spreading over the whole of Europe, northern Africa, and eastern Asia.

Arrangements are being made for the concentration of all collectible information upon the subject, and I shall be proud to act as the receiver of copies of any notes or records which your readers may intrust to me. G. J. SYMONS, F.R.S.

62 Camden Sq., London, N.W.,
Jan. 25, 1884.

[We shall publish Professor Karsten's article next week.]

Aeolian ripple-marks.

On the evening of June 11, 1883, after a severe rain-storm, during which large quantities of soil were washed from adjacent fields and deposited along the roadside, I noticed near Brodhead, Wis., a peculiar phenomenon, which may be worth recording. The mud, deposited only a few hours before, was still very mobile, and, at the point where best seen, covered an area a rod or more wide and three or four long, presenting a perfectly plane surface. The steady force of the strong wind was interrupted by occasional gusts of greater violence, each of which raised on the plastic mud-surface corrugations, which, in every detail that could be caught during their momentary existence, resembled ripple-marks formed by water, being a beautiful and distinct series of parallel ridges slightly concave toward the direction of the moulding-force. The outlines of these aeolian ripples were no sooner defined than they began to dissolve, and a minute or two sufficed to obliterate all trace of them. The phenomenon was observed several times on the same surface, and also in adjacent localities, where the consistence of the mud, and therefore the duration of the ridges, varied slightly. The ripples were best defined in the thinnest mud, though this was most favorably situated for their production; and they disappeared less rapidly where formed in the more viscous material.

This, of course, is not a radically new phenomenon, but a rare phase of the familiar action of wind on liquid surfaces. R. D. SALISBURY.

Winchell's 'World-life.'

Will you permit me to announce that a number of errata, attributable both to author and proof-reader, have found their way into my late work on 'World-life;' and I will be glad to mail slips of corrections to any who will kindly notify me by simple postal-card that they so desire?

ALEXANDER WINCHELL.

Ann Arbor, Mich.

THE LABORATORY IN MODERN SCIENCE.

THE material circumstances under which scientific discovery is prosecuted have been completely revolutionized during the last forty years. Of the immense changes that have occurred, the majority have fallen within the last fifteen, one might almost say dozen, years. It is interesting and profitable to contrast the past with the present in this respect.

Forty years ago there were very few, more properly no laboratories which we of to-day would consider even tolerable. Now every university of importance and high repute, the world over, has large suites of rooms for each department of science, and often numerous great buildings within whose walls thousands and thousands of students are daily brought face to face with the facts and laws of nature. The generation that is now gone pursued its scientific studies in incommodious quarters, and even those were destined for the use of the professors rather than the students. Many a small, dingy, and ill-lighted room is still to be seen, where some illustrious *savant* created new knowledge,— a small square chamber, with crooked walls, low ceiling, undulating floor,

and an insufficient window: what scientific traveller abroad has not seen that working-place, where his predecessors labored at the foundations of our existing science? Is not each of its forlorn details examined with a curiosity which is half wonder, half pity? Yet in such places were made the commencements of modern science.

Nowadays discovery has more seemly abodes. The great institutes which make the pride and glory of German universities are the models now being copied everywhere. By a guess we may estimate the number of laboratories equipped and intended for research at four or five hundred. The modern laboratory is a really new institution, the evolution of which still awaits its historian. Its origin appears to have been twofold: it grew, on the one hand, out of the museums; on the other, from the private collections of apparatus and materials belonging to the professors. The earliest museums were storehouses of curiosities,[1] but during the eighteenth century they gradually acquired a more scientific character. Not, however, until this century, did any of the museums attain great size; while the gigantic dimensions which a few, like those of Berlin, London, Paris, and Washington, have reached, are the result of very recent growth. Of course, special work-rooms have to be provided for those in charge of, or who come to study, such large collections; and, since the majority of scientific museums are connected with universities, the work-rooms in many of these institutions have become laboratories for students.

A great many of the older scientific men now living, and of the previous generation, got their little and imperfect practical training in private laboratories, which were the only ones existing in the earlier part of this century. Before long a few professors introduced, through their private energy, better equipment for the benefit of their laboratory students; and, when the demands exceeded their resources, these early enthusiasts obtained subventions from the university authorities. As these appropriations were increased, the private laboratory gradually became a university enterprise. Thus, Purkinje established his physiological laboratory at Breslau; Magnus, the physical laboratory at Berlin; and Liebig, the chemical at Giessen.

A good museum is very valuable, but a good laboratory is many times more valuable. Collections of any kind have, as such, a very limited utility, and even that only in very few sciences. The modern laboratory is almost unrestricted in its scope and possibilities. It is the most remarkable and influential creation of science in our time. It is a place well supplied with the necessary conveniences for watching and recording the special class of natural phenomena belonging to the science to which the particular laboratory is dedicated. Experience has shown that the appliances necessary for the exact observation of nature are numerous, varied, and costly: indeed, the thorough pursuit of any branch of science requires ample resources. Now, pure science does not lead to wealth: therefore students and investigators are compelled to rely upon the concentration of means and appliances in endowed laboratories to render their work possible. Association and co-operation, the characteristic social forces of our epoch, nowhere achieve more important results than in these laboratories, in which are produced the majority of current contributions to knowledge.

The expense of establishing and maintaining a good laboratory of any kind is far greater than is usually conceived. There are weights and volumes and temperatures to be measured, requiring delicate balances, graduated glasses, and fine thermometers; a great variety of glassware, lamps, stands, etc., is necessary; also reagents, standard fluids, and the like; next come the special supplies needed for the science to which the laboratory is devoted. It is astonishing how much like an assemblage of machinery the stock becomes even in those departments which require least. Next to be named is the material to work upon, which, in the natural-history sciences, is extensive, and has to be gathered from far and near. Finally, we mention as indispensable a small working-library, which ought to contain at least all those books that need to be frequently consulted, and sets of a few of the most valuable special journals. These conditions are more than fulfilled in many European laboratories, but by very, very few in this country. The architectural conditions are, on the whole, of subsidiary importance. There is no more common or egregious error than to suppose the erection of a building establishes a laboratory. In a handsome edifice something essential is often sacrificed to appearance: outside beauty is not indispensable to inside convenience. Half the cost of a building, given to endow the running-expenses of a laboratory, would in the majority of cases prove many fold more valuable.

A good scientific laboratory — that is to say, one in which original researches, as well as

[1] Of course the original 'musaeum' at the palace of Alexandria was altogether different.

mere teaching, may be undertaken (such a one as is found at universities, *de facto*) cannot be carried on properly and successfully by less than three persons. The highest officer must be the responsible director, — a man of superior ability, extensive attainments, and prolonged experience: one, in short, who has mastered his department of science, knows its possibilities and deficiencies, and is therefore capable of judging what work is most feasible and instructive for students, and what problems are best adapted for investigation. It is sheer waste for a man of such high capacity to sacrifice his whole time to the arrangement of apparatus, or the preparation of experiments for his lectures or his students: therefore it is desirable, we prefer to say indispensable, that he should have an assistant, preferably a young devotee of science, who will be fitted by his experience as an assistant to ultimately become himself director of a similar laboratory. The third person is the laboratory keeper (*diener*), who needs must be a man of some mechanical skill, so that the precious instruments may be safely intrusted to his care. He should be something more than a servant, and less than an assistant. A laboratory without this working-force cannot do much for the promotion of science, although even more modest ones may be valuable for simple instruction. A first-class laboratory, and in Germany are many such, has always a larger number of officers. There are few persons among us who appreciate the magnitude of a scientific laboratory: were it otherwise, there would not be so many petty substitutes for them.

Existing laboratories fulfil two functions, — giving education to students, and opportunity to investigators. The multiplication and enlargement of laboratories depend chiefly upon the growing recognition of the truth that first-hand knowledge is the only real knowledge. The student must see, and not rest satisfied with being told. Translated into a pedagogic law, it reads, 'To teach science, have a laboratory; to learn a science, go to a laboratory.' He who has never learned to appreciate a laboratory in its highest sense does not know even the meaning of 'I know.' We do not consider those liberally educated who have never had even a single thorough course of laboratory training. It is the laboratory which gives strength to the movement in favor of scientific education, for it opens to all the road to real living knowledge; while books by themselves lead off to the by-ways of what other men thought they knew at the time they wrote. Life and death are not more different than are, in their ways, real and book knowledge of nature. A book, at best, is but a useful adjunct in science.

To the investigator the laboratory is, or ought to be, all in all, providing him with every thing wherewith to experiment and observe. Not only should there be on hand all the paraphernalia of research, but it must also be possible to purchase or construct the new apparatus which may be devised to meet the new requirements. Yet in no respect, perhaps, do laboratories maintain a more efficient utility than in fostering technique, by the development of new methods, and by gathering from all sources complete information concerning the available processes and means of work. Only the daily laborer at science can adequately value the knowledge of methods which is concentrated in every well-managed laboratory. In places where these requirements are fulfilled, discovery makes rapid progress; and their existence explains the present immense rapidity of scientific progress.

What a contrast between the magnificent opportunities we enjoy to-day and the meagre possibilities of fifty years ago! The change has been rendered possible by the establishment of well-fitted laboratories for the promotion of science.

TESTS OF ELECTRIC-LIGHT SYSTEMS AT THE CINCINNATI EXPOSITION.

THE commissioners of the eleventh industrial exposition held in Cincinnati in September and October, 1883, determined to undertake a series of tests of the efficiency of electrical lighting systems, and so advertised in their circulars, which were widely distributed. Special premiums were offered for the best system of arc-lighting, the best system of incandescent lighting, the best dynamo machine for arc and incandescent lighting respectively, and for the best lamp in each system.

A jury was appointed by the commissioners, consisting of T. C. Mendenhall, chairman, H. T. Eddy, Thomas French, jun., and Walter Laidlaw. The jury was instructed to make such tests and measurements as seemed desirable and were possible under the circumstances, and which would aid in arriving at a verdict upon the relative merits of the different exhibits.

The opening of the exposition took place on Sept. 5, and the close on Oct. 6. The jury was requested to make its report of the awards one week before the close of the exposition.

In response to the proposal of the commis-

sioners, four systems of electric lighting were entered for competition. The Thomson-Houston electric-lighting company submitted a system of arc-lighting; the Edison electric-lighting company, a system of incandescent lighting; and the U. S. electric-lighting company offered a system of arc-lighting, and also one for incandescent lighting. Several things conspired to make the tests less complete in some respects than was desired by those interested. The members of the jury were all engaged in professional work, and were therefore unable to devote their entire time to the tests. The dynamometers used were built after the exposition opened, and were not completed until after many vexatious delays. One of them, that upon which the most reliance was placed, was of a form recently devised, and the principles of which had never been realized in practice, except in an experimental model constructed by its inventor. Its construction on a large scale necessarily involved a good deal of experimentation. In spite of these delays, the jury was enabled to begin regular work on the evening of Sept. 25, and to make, during the succeeding ten days, such tests of the most important features of the various systems as to justify them in making the awards, whatever difference might have existed in reference to minor points, which, for lack of time, were not thoroughly investigated.

The plan adopted was substantially that upon which nearly all similar trials have been conducted. The energy consumed by the dynamo was measured by means of the dynamometers, and the electrical energy in the circuit was determined by well-known methods. This gave the efficiency of the machine as a generator. The illuminating-power of the lamps was compared, and at the same time the electrical energy which they consumed was measured. A combination of the results obtained by these two processes gives the relative illuminating-power per unit of energy consumed by the dynamo, which represents the relative commercial efficiencies of the systems. The measurements made, therefore, were of three kinds, — dynamometric, electric, and photometric; and they will be considered in the order mentioned.

Dynamometric measurements.

Two separate dynamometers were simultaneously employed in measuring the mechanical energy expended in running the armatures of the four dynamos which were tested. They have been called, from the manner of their operation, the 'belt' and 'cradle' dynamometers respectively.

The belt dynamometer has been frequently employed before; and its manner of operation is explained by Dr. Hopkinson in *Engineering*, vol. 27, p. 403, where he gives a figure of it, and the formulae used by him in determining the power expended in certain electric-light tests. These formulae tacitly assume that the belt is perfectly flexible and without weight: for otherwise terms must be introduced into the formulae to take account of the differences of tension in the belt caused by passing the dynamometer-pulleys, and the centrifugal force generated in the belt as it leaves the various pulleys. The velocity of the belt being great, it is more than probable that such terms are required in order to deduce accurate results from this form of dynamometer.

Under these circumstances the computation of the power expended from the observations of the belt dynamometer by the theory as at present known was wholly unsatisfactory, giving results, in all except the first few tests, considerably less than the truth, and in some cases less than the electrical power in the circuit.

The cradle dynamometer, however, gave results of a much more satisfactory character. The principle of this dynamometer is a recent invention of Professor Brackett of Princeton, N.J., and, owing to its novelty and great accuracy, merits a somewhat minute description. It was built at the machine-shops of Messrs. Lane & Bodley, Cincinnati, under the superintendence of Mr. Laidlaw, from designs made by Mr. Eddy, to whom is due the arrangement of its various parts.

It consisted of a substantial platform, *cc*, fig. 1, seven feet long by four and a half feet wide, hung at each end by iron rods, *ee*, from an axis consisting of a short piece of two-and-a-half-inch shafting, *a*, which rested upon a supporting-girder, *gg*. Fig. 1 represents the framework, etc., at one end of the platform, to facilitate raising and lowering the girder *gg*, which carried the platform *cc* by means of the jackscrews *jj*, upon which *gg* rests. The uprights *bb* are guides passing through the openings *bb*, shown in fig. 2, which is intended to represent the ground-plan of *gg*, and adjacent parts of the cradle. Each girder, *gg*, was composed of two planks, held at a distance of three inches apart by blocks, *dd*, and bolted firmly together. The rods *ee* passed between the planks *gg*, and were forged to an eye which fitted the axis *a*. The axis *a* rested upon pieces of smooth boiler-plate in the upper surface of *gg*.

The uprights *bb* form part of a rigid framework, well bolted together, one side of which is seen in outline on a smaller scale in fig. 3.

A scale-beam, *ff*, made in the form of an inverted L, and graduated to fractions of an inch, had the lower extremity of its vertical arm fastened to the platform *cc;* while at the angle was an eye which was centred upon *a* by the screws *iii*.

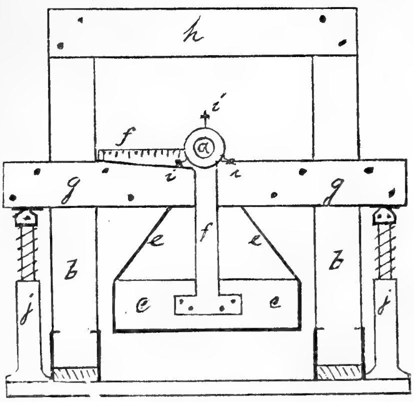


FIG. 1.

It is readily seen that the platform, when it was raised from the ground, as shown in fig. 1, was free to swing through a limited space, either to the right or left, and that any eccentric weight or force so applied as to tend to swing it to the left could be compensated by a weight upon the scale-beam, *ff*, which swings with it; so that the platform could be still kept in its horizontal position.

The axis about which the swinging tends to occur is the line of contact between *aa* and *gg*, which line we shall for brevity henceforth call the axis *aa*.

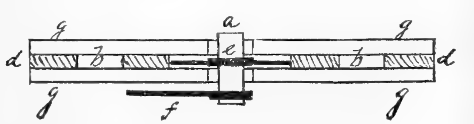


FIG. 2.

In setting up the dynamometer, it was so placed that the axis *aa* was directly below the axis of the driving-pulley, and in the same vertical plane with it. The dynamo to be tested was placed upon the platform *cc*, while *cc* was resting upon the ground; and it was blocked up on *cc* to such a height, that the axis of the armature was as nearly at the same height as the axis *aa* as could be readily done by direct measurement. This adjustment could be effected with all necessary exactness once for all; for, even though the armature were slightly above or below the axis *aa*, no error would thereby be introduced into the observations.

The axis of the armature was also set, as nearly as it could be conveniently, in line with the axis *aa;* but the final adjustment, so that the centre of the armature-pulley was neither to the right nor left of the axis *aa*, was made mechanically as follows. The platform and dynamo were raised from the ground, and the girders *gg* carefully levelled by means of the jackscrews. The platform was then brought to a horizontal position by placing compensating weights upon it. The belt was next adjusted, and was tightened by lowering the platform. It was then found, that, in case the axis of the armature was to the right or left of *aa*, the tension of the belt exerted a force to tip the platform, and it no longer stood horizontal. This was corrected, — one half, by shifting compensating weights; and the other half, by moving the dynamo to the right or left. The belt was then slackened by raising the platform, and a similar adjustment again made to bring the platform to the horizontal position. This was repeated until the platform stood horizontal, whether the belt was tight or loose; both girders being at the same height, and both accurately levelled, account being taken of the bending.

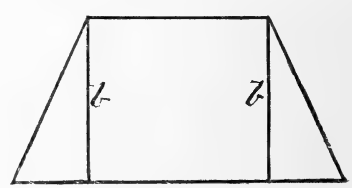


FIG. 3.

A further application of compensating weights was employed to render the balance sensitive. With the Edison dynamo, which is top-heavy (i.e., its centre of gravity is above the axis of the armature), more than a ton was hung on the sides of the platform to bring the centre of gravity of the whole down to the axis *aa*. With the other dynamos, whose centres of gravity are below the axis of their armatures, compensating weights of smaller amount were placed upon a staging built on the platform above the dynamos, in order to bring the centre of gravity of the whole up nearly to the axis *aa*.

In making the tests, the power was applied to turn the armatures clockwise in fig. 1. This caused the horizontal scale-beam *f* to rise; and weights were placed upon it to bring it back to the horizontal position. The moment of

the couple, got by multiplying the weight so applied by its distance from the axis *aa* as read upon the scale-beam, is evidently equal and opposite to the moment of the couple with which the armature is turned. Thus the moment of the force applied to run the armature was measured in foot-pounds. This moment, multiplied by the number of revolutions per minute and by 2π, is the work expended in driving the armature, in foot-pounds per minute.

It was found convenient to use a weight having a moment somewhat less than sufficient to bring the scale-beam to the horizontal, and employ a Chattillon spring-balance with a dial-face reading to 2 oz. to furnish the remaining part of the couple. This balance was fastened to a vertical cord passing around a small winch, which enabled the observer to bring the scale-beam to the horizontal with facility.

The principal difficulty to be apprehended in testing with this dynamometer was a possible tendency to oscillation, which might be caused by running the belt. Had this existed, it might have been checked by a dash-pot; but the weight of the platform and dynamo was sufficient to almost entirely obviate any such difficulty, and give very considerable steadiness of position. Indeed, the jarring seemed to increase its sensitiveness, and evidently enabled the platform to come to rest in its position of equilibrium by overcoming any initial friction existing.

The structure was mostly built of three-inch plank, ten or twelve inches wide. The platform was designed to safely carry five tons at its centre.

For permission to make use of the cradle dynamometer, the jury is indebted to the kindness of Professor Brackett.

In addition to the use of the two dynamometers described, indicator-diagrams were taken from the steam-engine furnishing the power for driving the dynamo machines. Throughout the dynamometric tests the machines were driven by a Cummer engine of about a hundred horse-power, which furnished power for other dynamos than that upon the cradle, as well as for two or three pieces of machinery on exhibition in Power Hall. It was thus impossible to make the taking of indicator-diagrams contemporaneous with the regular tests, owing to the large load which the engine carried; and they were generally taken after ten o'clock at night, at which hour the remainder of the load was thrown off. Although these indicator-cards were not used in the final computations, they furnished valuable checks upon the performance of the dynamometers.

The electrical measurements.

For the purpose of making the electrical measurements as free from disturbance as possible, a small room, about twenty feet long and ten feet wide, was fitted up in the basement of the central part of the large exposition building. In this, three brick piers were built upon solid foundations, and two or three wooden brackets were firmly secured to the walls, so as to furnish firm resting-places for the galvanometers. The main lines of the arc-lighting systems were run through this room, and very heavy copper conductors connected the room with the space in which the dynamos were exhibited; so that the entire current from the incandescent machines could be introduced when desired.

The electric measurements consisted in the determination of the strength of the current, and the electromotive force between two points in the circuit. For this purpose several galvanometers of different kinds were employed. For the measurement of current strength the principal instrument used was one of Sir William Thomson's current galvanometers, made by White of Glasgow. Although of recent invention and construction, the instrument is probably so well known as not to require any detailed description. It consists essentially of a magnetometer, and a coil of very low resistance. In the magnetometer four short magnets are combined to form a needle, the position of which is indicated by a very light yet very rigid aluminum index. A steel magnet, bent in the shape of a semicircle, is placed in a vertical plane over the needle, so that the latter is approximately at the centre of the circle of which the magnet forms a part. One end of the magnet is furnished with a cross-piece of brass, from one extremity of which projects a pin which rests in a conical hole, and upon the other extremity is a 'button;' so that freedom of motion around the pin as an axis is allowed. The opposite end of the magnet rests in a groove cut around the end of a screw, by the movement of which the plane of the magnet can be shifted towards the east or towards the west.

The coil is fixed in a vertical plane at one end of a wooden table whose length is about one foot, and breadth about five inches. The table is furnished with levelling-screws, and a V-groove is cut lengthwise through the centre, at right angles to the plane of the coil. In

this groove the magnetometer, with its attached magnet, slides; so that, by placing the needle at different distances from the centre of the coil, the instrument may be used for measuring currents differing very greatly in strength.

The adjustment of the instrument consists in placing the magnetometer upon the table, without the field-magnet, and adjusting the whole so that the index is at zero of its scale; after which the magnet is put in its place, and, if necessary, one end is moved by means of the screw until the index again points to zero.

The interpretation of the reading of the instrument is a very simple operation. A scale along the edge of the V-groove shows the position of the magnetometer. It is necessary to know the strength of field at the needle, which is, of course, that due to the magnet, plus the horizontal component of the earth's magnetism; and then, if this strength of field in C.G.S. units be multiplied by the reading of the needle, and divided by the scale-reading of the magnetometer, the result will be the current in ampères.

This galvanometer was permanently mounted on one of the stone piers, and its connections were so arranged that it could be quickly thrown in or out of the circuit without interfering with the continuity of the same. The direction of the current through the galvanometer could be instantly reversed; and throughout the observations reversals were regularly made, so as to eliminate error arising from displacement of the zero. The zero-point was adjusted, however, at the beginning of every series of observations, and examined at frequent intervals during the same.

A differential galvanometer was also used in measuring current strength. This instrument was kindly loaned to the jury by Professor Brackett of Princeton, by whom it was devised and constructed. A description of it will be found in the *American journal of science*, vol. xxi. p. 395. It consists essentially of two heavy rings, one within the other, through which the current goes in opposite directions. The needle in the centre has a silk-fibre suspension. The radii of the rings being given, the constant of the instrument can be readily calculated. It was especially constructed for the measurement of strong currents, ten ampères giving a deflection of fourteen to fifteen degrees when the value of H is a little more than .2. When the current was steady, it behaved admirably; but with a fluctuating current it became extremely difficult to get trustworthy readings, owing to the constant vibration of the needle. The graduated circle was so small that the estimation of fractions of a degree was quite uncertain. Even with steady currents, more time was required for reading the Brackett than the Thomson, owing to the length of time needed for the needle to come to rest after a reversal of current. For these reasons its use was not continued throughout the test. It was observed continuously during the tests of the Thomson-Houston dynamo, and during a part of the tests of the Weston dynamo, when, owing to fluctuation in the current, its use was necessarily discontinued. It served a useful purpose, however, as a check upon the indications of the Thomson instrument, the close agreement of the two justifying confidence in the indications of the latter. The most carefully made series of comparisons was that of Sept. 20. During the afternoon of that day, eight simultaneous readings of the two instruments were made; the current, which was remarkably steady, being furnished by the Thomson-Houston dynamo. The means gave 9.92 ampères as indicated by the Thomson, and 9.93 ampères for the Brackett. The regular tests were begun on Sept. 25, and in the mean time several additional conducting-wires had been brought into the testing-room. The indications of the Brackett galvanometer were, after this, constantly somewhat less than those of the Thomson, which was doubtless due to the alteration of the field by the presence of the currents. The difference was quite constant, and amounted to about two per cent. Thus, on Sept. 25 the Thomson gave 9.97 ampères, and the Brackett 9.77. On the 26th the Thomson indicated 10.0, and the Brackett 9.80, and on the 27th, with the Weston arc dynamo, showed 18.6 ampères, and the Brackett 18.3. That this discrepancy could be accounted for by the effect of the current upon the strength of field was established by vibrating a needle under two conditions, — with and without the currents. Herein is shown the advantage of a strong, permanent magnetic field, such as exists in the Thomson instrument. An alteration of the field, which might considerably influence the results from the Brackett, would hardly be perceptible with the Thomson.

During the tests of the arc-light machines the whole current was taken through the galvanometers. With the incandescent systems, however, in which the current was sometimes as high as 170 ampères, this was impossible; as the coils and connections would have been greatly heated. The current might possibly have been safely divided between four or five instruments; but, these not being at hand, it became necessary to make use of a shunt.

For this purpose the heavy main conductor was cut, and the two ends were inserted into large mercury-cups, cut out in a block of wood an inch and a half thick. These cups were also connected by about forty feet of number 0 copper wire, the ends of both main and shunt wire being well immersed in the mercury, and pressed close together. These mercury-cups were connected with two others by means of short copper wires, and into the second pair the ends of the galvanometer wires were plunged. As thus arranged, about one-fifth of the current was taken through the galvanometer. Even with this division of the current, it was found, that, when using the strong current from the Weston dynamo, the wires of the galvanometer were somewhat heated; and in order to avoid this result, a short piece of number 0 wire, not more than two or three inches in length, was bent so that it could be inserted in the mercury-cups, and thus cut the galvanometer out, except during the few moments necessary for taking a reading. During all of the 'resting' periods this short wire carried by far the greater portion of the current, and thus tended to prevent the heating of the shunt wire proper as well as of the galvanometer.

The determination of the ratio of the two parts into which the current was divided, or the value of the 'shunt multiplier,' was, of course, a matter of great importance. In the preliminary measurement of this ratio the current from the Thomson-Houston machine was of great service on account of its steadiness. To begin with, a number of tests were made to discover if the connection resistances were of such importance that any accidental variation in them would perceptibly alter the shunt ratio. The shunt was repeatedly lifted out of the cups and replaced, and the galvanometer connections were broken and remade. Every thing that could be disturbed was disturbed; but, upon reconstruction, the result was found in all cases to be practically unaltered. On Sept. 28 a series of twenty measurements was made with the shunt alternately in and out, using a current of 10 ampères. The results agreed closely with each other, and gave 4.6 as the value of the shunt multiplier. On the following day the tests of the incandescent machines began; and the shunt was not moved from its position, nor disturbed, until after the conclusion of the entire work. On Oct. 3, after all of the regular tests had been completed, another test of the shunt was made, with a current of 10 ampères, as before. Ten observations were made, all of which agreed in giving a ratio of a little more than 5.0. This result was quite unexpected, and the discrepancy between it and that obtained from the first test was entirely too great to be accounted for by errors of observation. As circumstances prevented further tests in Cincinnati, it was determined to remove the shunt and all connections to the physical laboratory of the Ohio state university, where a thorough examination of the cause of the difference could be made. This was done; but, before any experimental examination had been undertaken, the origin of the difficulty suggested itself. The two short wires connecting the mercury-cups had been in one case thrown with the galvanometer doubtless, and in the other with the shunt. It was perfectly certain, however, that throughout the tests they had formed a part of the galvanometer. Upon examination, this explanation was at once found to be correct. The shunt and galvanometer were connected up precisely as they had been in Cincinnati: and a series of twenty-five observations gave, when the small wires were a part of the shunt, a multiplier of 4.60; and, when they formed a part of the galvanometer circuit, it was 5.01. The measurements were made by comparing the resistance of the two parts of the circuit by means of the fall in potential, as shown by a Thomson's reflecting galvanometer of high resistance. While in use in Cincinnati, the shunt was constantly carrying a portion of the current; and its temperature was therefore always slightly higher than that of the galvanometer. The difference was small, and it could not be measured accurately; but, on account of its existence, it was thought proper to adjust the shunt multiplier. An excess of heat in the shunt would throw a greater amount of the current through the galvanometer than would go there if the two were at the same temperature: accordingly, the value accepted was 4.9 instead of 5.0, as indicated by the comparison, in which the currents used were much weaker than those transmitted during the tests. It will be observed, the existence of an excess of temperature in the shunt favors somewhat the system in which the stronger current was transmitted.

In the measurements of electromotive force, Thomson's potential galvanometer, by White, was used. In the beginning a large number of comparison observations were made, in which the same electromotive force was measured by this instrument and by the well-known method of discharging a condenser through a high-resistance galvanometer.

A condenser of one-half micro-farad capacity, and a reflecting galvanometer of nearly seven thousand ohms resistance, both by Elliot Broth-

ers, were used with a battery of ten Daniell cells in good condition. These comparisons proved that the indications of the potential galvanometer could be relied upon as trustworthy within practical limits, and in the actual tests it alone was used on account of the greater convenience and rapidity with which observations could be made. Further tests of its accuracy were made, however, which will be referred to later. It is sufficient to say, that this instrument, in form and construction, is quite similar to the current galvanometer already described, except that the coil has a resistance of nearly seven thousand ohms. A key is placed in the circuit, so that the current passes through the coil only during the few moments necessary to secure a reading, thus preventing the heating of the coil. The difference of potential in volts, between the two points to which the leading wires are connected, is found by the same process as is used for reducing the readings of the current galvanometer to ampères. In measuring the efficiency of the dynamos, wires were brought from their binding-posts to the galvanometer. In the arc-light machines the electromotive force was high, amounting to more than twelve hundred volts in the Thomson-Houston dynamo; and it was therefore desirable to introduce extra resistance in the galvanometer circuit. From resistance-boxes made by Elliot Brothers, an amount equal to seventeen times the resistance of the galvanometer was thrown in, thus bringing the fall in potential in the galvanometer within easy range. Great care was taken to see that the coils were not heated during these measurements; and for this purpose the boxes were opened, and the coils exposed to the air, frequent examination being made to see that no rise in temperature took place. Precisely the same arrangement existed throughout the tests of both arc systems. During the photometric tests the wires of the potential galvanometer were attached directly to the lamp under test, so that the fall in potential through the lamp only was measured.

Photometric measurements.

Unquestionably, the most difficult question to deal with, in work of this kind, is the question of photometry. The expression of illuminating-power in 'candles' is a matter of great uncertainty, arising from the uncertain character of the standard, and also from the great inequality existing in the intensity and composition of the lights which are brought into comparison. As the test was intended to be purely competitive, the jury decided to ignore the question of 'candle-power' entirely, and confine itself to a comparison of the lights under consideration. It is believed that the adoption of this plan rendered the results free from many errors to which they would otherwise have been liable.

The photometric comparisons were made by means of the ordinary Bunsen disk photometer, as modified by Letheby. Some preliminary experiments were made with one of Glan's spectrum photometers, for the use of which the jury was again indebted to the kindness of Professor Brackett. The adjustments of this instrument are delicate, and observations cannot be made so rapidly with it as with the ordinary disk photometer; so that, in consideration of the limited time at the disposal of the jury, it was decided not to attempt its general use throughout the tests. It was hoped and intended, in the beginning, to make a thorough examination of the composition of the different lights; but unforeseen delays in the preparation of other portions of the machinery of the test forbade this. As the candle was not made use of, all the lights which were compared were more nearly of the same composition, and thus much of the difficulty in the use of the disk photometer did not appear.

It was found most convenient to make the comparison of the arc-lights through one of the incandescent lamps, as the steadiness and constancy of these could be depended upon during the time necessary for a comparison. In these measurements, a long gallery in the basement of the main building, and adjoining the testing-room, made it possible to place the two lights which were being compared at a distance of fifty feet from each other. The line extended into the testing-room, where the photometer-bar, ten feet in length, was placed. An Edison incandescent lamp, nominally of sixteen candle-power, was used as a standard. In the first series of experiments, comparisons were made with the arc-lamps in three different positions; five readings of the position of the photometer-box and of the galvanometers being made at each position. The lamp was first suspended in its normal, vertical position; then afterwards it was inclined at an angle of forty-five degrees, first with its base away from the photometer-box, and afterwards with its base towards the same. After such a series had been completed with one of the two lamps in competition, it was at once removed, and its place was supplied by the other. On the following night the comparison was continued, other lamps having been selected; but the lamps were tested in only two

positions, — the normal position, and that in which the base of the lamp was towards the photometer-box; these being regarded as the positions of the greatest importance. Altogether, twenty-five photometric observations were made in comparing the arc-lamps. The lamps compared were taken at random from those in use by the exhibiters.

The comparison of incandescent lamps presents questions of far greater delicacy and difficulty. There is one element, in the economy of an incandescent lamp, which does not enter to any extent in the consideration of arc-lamps; that is, the life of the lamp. Although of great importance, it did not seem possible, in the limited time which was at the disposal of the jury, to investigate this point. The only fair and impartial method of making such an investigation, involved, in the opinion of the jury, the continuous and prolonged burning of a large number of lamps belonging to the different competing systems. Under the circumstances, it was absolutely impossible to make use of this method.

There exists, also, difference of opinion as to the proper method of comparing the efficiency of two incandescent lamps. They may be reduced to the same illuminating-power, and the electrical energy consumed by each may be compared; they may be brought to a condition in which they consume the same electrical energy, and their illuminating-power compared; or they may be allowed to differ in both of these elements, and comparisons be made in both.

The first method has been pursued in several tests which have been made both in Europe and in this country.

Incandescent lamps are generally made to be equal, nominally, to a given number of standard candles; but, by modifying the consumption of energy, a lamp of nominally low candle-power can be made to produce almost any degree of illumination, from nothing up to the equivalent of several hundred candles, the high illumination being, of course, at the expense of the life of the lamp. If this element is left out of consideration, the efficiency of a lamp increases rapidly with its degree of incandescence. As it is by no means necessary that incandescent lamps should run at a fixed 'candle-power,' it will follow that the temperature at which a lamp will show greatest efficiency (including the life element) will depend greatly upon its construction.

Taking two lamps of radically different construction, however, there will be for each a certain set of conditions as to current strength and electromotive force, and including the element of life, under which it would show its highest efficiency and economy. After such conditions were determined for each lamp, a strict comparison would be possible. The reduction of two such lamps to the same degree of illumination would probably be unfair to one or the other, or possibly to both, if the element of life is not considered.

Suppose that a lamp in one system is at its best, *all things considered*, at fifteen candle-power, and that one in another reaches its highest degree of efficiency at sixteen candle-power. If they are both brought to fifteen candle-power, the second must suffer in the comparison; and if both are brought to sixteen candle-power, *and the element of life is not considered*, it will again suffer, for the apparent efficiency of the first will be increased by its higher incandescence.

As the labor of determining the most favorable conditions for each lamp would be so great as to necessarily throw that method out of consideration, the jury felt constrained to adopt the last of the three methods mentioned above. The jury assumed, in fact, that the exhibiters of the different systems had already determined these favorable conditions in their own interest; and that in putting their lamps before the public for the entire period of the exposition, each maintaining more than two hundred lamps in different parts of the exposition building, they would operate them as nearly as possible in accordance therewith. In other words, it was decided to compare the lamps as they were used in the exhibit, determining the ratio of their illuminating-power, and measuring the electrical energy consumed by each. It is proper to state, that the lamps of both systems were spoken of by their respective representatives as sixteen candle-power lamps, although certain marks on the lamps which were supposed by the jury to refer to candle-power did not exactly agree.

To secure impartiality of selection, the jury requested permission to have access to the supply of lamps kept by each company for use in the exhibit, which permission was freely granted. From each, ten or twelve were selected at random, and carried to the testing-room; and from these the lamps which were compared were taken. They were placed upon the photometer-bar at a distance of a hundred and twenty-five inches from each other, and a system of switches was arranged, so that the galvanometers could be quickly connected with one or the other. Measures of current and electromotive force were made

rapidly and continuously during the photometric comparison.

Neither of the two lamps under test illuminated equally in all directions. They were therefore compared in nine different positions, each lamp assuming three, which were designated respectively, 'flat,' 'edgewise,' and 'forty-five degrees;' and each position of one was compared with all of the other. Five sets of readings were made at each position, making, in all, forty-five comparisons of the two lamps. A number of preliminary comparisons were made, which were not considered as forming a part of the actual test. The latter was made on the evening of Sept. 29.

The determination of the efficiency of the dynamos consisted in measuring the power consumed, as shown by the dynamometer, on the cradle of which the dynamo was placed, and at the same time measuring the current and the electromotive force at the binding-posts of the machine. The speed of the main shaft being nearly uniform, it was necessary to place different pulleys upon it, in order to secure the necessary speed for the armatures of the different machines. The speed of running being a matter which concerned the exhibiters rather than the jury, they were requested to furnish the dimensions of these pulleys, and accordingly did so. The average speed of the armature of the Weston dynamo for incandescent lamps was a little above ten hundred and thirty revolutions per minute, during three different series of observations made while the machine was on the cradle. The Edison dynamo was placed on the cradle on the afternoon of Oct. 2, when a series of measurements was made with an average speed of ten hundred and sixty-eight revolutions. This was above what may be called the 'normal speed,' which was due partly to the size of the pulley, and partly to the fact that the engine was doing but little other work, and was probably running a little above its normal rate. In the evening the tests were continued, the speed of the armature being a little below a thousand revolutions, the electromotive force being also less. It will be observed that the 'efficiency' of this dynamo, under the latter conditions, differs from that under the former by only two-tenths of one per cent. Particular attention is called to the fact, that no photometric measurements were made with lamps on the circuit of the Edison machine, which was on the dynamometer; those used being supplied from another similar dynamo, which was run by an Armington and Sims engine, which formed a part of the Edison exhibit. A glance at the results given below will show that the electromotive force in the latter case was much lower than in the former.

Tests of the galvanometers.

Although the jury was satisfied of the accuracy of the Thomson galvanometers, within all practical limits, before deciding to rely upon their indications, for reasons that need not be referred to here, it was considered desirable, after the conclusion of the tests, to make such an examination of them as would leave no doubt as to the correctness of this opinion. The chief cause of error in these instruments, and in all of a similar construction, is the possible variation in the strength of the permanent magnets which establish the field in which the needles move. The existence of a strong field is a great advantage, as has already been pointed out, provided its value is known. An examination of the instruments was made before they were taken to Cincinnati; and then, again, when they were mounted in the testing-room, they were compared with others not liable to such alterations, as before related. Numerous tests were made to ascertain if each instrument was consistent with itself by measuring the same quantity with the magnetometer at different points of its scale, thus varying the position of the needle; and the results were satisfactory. Finally, after the instruments were returned to the physical laboratory of the Ohio state university, they were subjected to tests, a brief account of which is as follows: —

For the potential galvanometer, ten cells of the 'gravity battery,' — the elements of which were zinc, zinc sulphate, copper sulphate, and copper, — in good condition, were individually compared by the condenser method with a standard Daniell cell set up for the purpose. They differed very little among themselves; and when the electromotive force of the ten, in series, was measured by means of the Thomson instrument, the resulting electromotive force of the Daniell was 1.106 volts. The instrument was also compared with one of Ayrton and Perry's voltmeters, kindly furnished for the purpose by the Electric supply company of New-York City. For this purpose recourse was had to an Edison lighting-plant, the instruments being applied to the same lamp. The fall in potential in the lamp was at first 110 volts, which was beyond the range of the Ayrton and Perry instrument; but it was reduced a little below 100 volts, and two measurements were taken with each instrument.

The Thomson read the same in both measurements, making the electromotive force 97.6 volts. The divisions on the scale of the Ayrton and Perry were very small, making the reading quite difficult. From it were obtained, in the two measurements, 96.1 and 95.5 volts.

Assuming that the field of the potential galvanometer is known, it is easy to determine that of the current galvanometer, as the magnets are interchangeable. A series of observations was made in which a practically constant quantity was measured, first with one of these magnets on the magnetometer, and then with the other, alternating throughout the series. Twelve observations made in this way show a mean difference of 1.75% between the two magnetic fields. In the numbers used in these tests the difference is 2%.

The current galvanometer was also compared with an Ayrton and Perry ammeter at the same time at which the potential instruments were compared. The circumstances did not allow the use of a stronger current than that passing through a single Edison lamp. The result was therefore not of great value. The Thomson showed 1.05 ampères, and the Ayrton and Perry gave 1.03 for the same current.

Several tests of the current galvanometer were made by means of a battery of five Grove cells, which were freshly set up. The reading of the galvanometer was noted, and then a resistance of one ohm was introduced into the circuit. The first reading was 19, and the second was 9.5; showing that the resistance of the battery and galvanometer was one ohm. The electromotive force of the battery was then determined by means of the potential galvanometer. Two measurements were made; the first giving 9.43 volts, and the second 9.56 volts. Assuming the resistance to be one ohm, as shown above, these numbers would represent, in accordance with Ohm's law, the current in ampères. The current, as calculated from the galvanometer reading, was 9.5 ampères.

Many other tests of a similar character were made, all of which showed that the galvanometers must be admitted to be what they were assumed to be during the tests, — practically correct. But, even if they were somewhat in error, the similarity of conditions under which the competing systems were tested was such that all would be affected alike.

Results.

In determining the efficiency of the dynamos, after every thing was found to be in good order, a run of about half an hour was made; during which time readings were taken every two minutes, as nearly as could be, of the dynamometers and electrical instruments. Generally from ten to twenty sets of readings were secured. In most cases two or more 'runs' were made; the repetition being in some instances the desire of the jury, and in others of the exhibiters. Sometimes the conditions under which the dynamo was running were changed by the exhibiters, with the expectation, doubtless, of increasing its efficiency thereby. In the following summary of results, the numbers showing the electromotive force, current strength, power consumed, etc., are means of a number of observations.

Photometry of arc-lamps.

The table on the next page shows the results of the photometric comparison of the two arc-lamps, and will be easily understood. The arrows show the direction of the light measured in each series: thus, ← means a horizontal measurement; ↖ means that the measurement was of the light going upward at an angle of forty-five degrees; and ↙ refers to the light going downward at an angle of forty-five degrees. For convenience, the intensity in terms of the standard (an Edison incandescent lamp) is multiplied by 1,000 before dividing by the number of Watts.

It will be seen that the different lamps differed from each other considerably in their efficiency. This was especially true of the Weston lamp, which was irregular in its ac-

Efficiency of dynamos.

	Thomson-Houston dynamo for arc lighting.		Weston dynamo for arc lighting.	Weston dynamo for incandescent lighting.			Edison dynamo for incandescent lighting.	
	Sept. 25.	Sept. 26.	Sept. 28.	Sept. 29.			Oct. 2.	
Electromotive force, in volts	1232.0	1175.0	626.0	69.2	60.0	65.0	124.9	122.8
Current in ampères	10.03	10.08	20.3	168.1	145.7	157.4	124.7	119.3
Electrical horse-power	16.6	15.9	17.0	15.6	11.7	13.7	20.9	19.6
Horse-power consumed	19.32	20.59	19.75	18.55	12.8	15.5	21.96	20.64
Percentage of efficiency	85.9	77.2	86.5	84.1	91.4	88.4	95.2	95.0

Arc-lamps.

Thomson-Houston.						Weston.					
Direction of light.	Current.	Electro-motive force.	Watts.	Intensity in terms of standard.	$\frac{1000\ I}{W}$	Direction of light.	Current.	Electro-motive force.	Watts.	Intensity in terms of standard.	$\frac{1000\ I}{W}$
←	10.2	45.9	467	16.2	34.7	←	20.7	23.9	495	25.9	52.4
↖	10.2	46.7	475	13.2	27.8	↖	20.1	23.3	469	17.6	37.4
↙	10.2	46.3	471	85.0	180.3	↙	19.8	21.9	435	32.3	74.4
Other lamps.											
←	10.1	46.1	465	18.0	38.8	←	20.0	25.6	512	30.7	59.9
↙	10.2	46.3	474	98.8	209.0	↙	20.8	25.0	522	51.7	99.2
Means.											
←	–	–	–	17.1	36.7	←	–	–	–	28.3	56.1
↖	–	–	–	13.2	27.8	↖	–	–	–	17.6	37.4
↙	–	–	–	91.9	194.6	↙	–	–	–	42.0	86.8
General means.											
	..	–	–	40.7	86.4		–	–	–	29.3	60.1

tion. The numbers under the head of 'General means' show the average light in terms of the standard, in all directions measured, and the relative illuminating-power per unit of energy. There is a difference of more than forty per cent in favor of the Thomson-Houston.

Photometry of incandescent lamps.

The table below, showing the results of the photometric comparison of the incandescent lamps, will need but little explanation. In the first column the relative position of the carbon filaments is shown: thus, | | means that they were parallel to each other, and at right angles to the photometer-bar. The three positions of a lamp were designated as 'flat' (|), 'edgewise' (—), and 'forty-five degrees' (\ or /). $\frac{W_E}{W_M}$ denotes the Watts of the Edison divided by the Watts of the Maxim. The column headed $\frac{E}{M}$ shows the actual illuminating-power of the Edison, compared with the Maxim as a unit; and the numbers are the squares of the ratios of their respective distances from the photometer-box. The numbers in this column, divided by those in the one preceding, give the numbers in the last column, headed $\frac{E_E}{M_E}$, or the

Incandescent lamps.

Position.		Edison.			Maxim.			$\frac{W_E}{W_M}$	$\frac{E}{M}$	$\frac{E_E}{M_E}$
Edison.	Maxim.	Current.	Electrom. force.	Watts.	Current.	Electrom. force.	Watts.			
|	|	.648	113.0	73.2	.887	63.7	56.5	1.30	1.11	.855
/	|	.639	114.7	72.5	.887	64.5	57.2	1.26	1.13	.891
—	|	.636	114.6	72.9	.870	61.8	53.7	1.36	1.28	.941
—	\	.622	115.4	71.8	.853	62.2	53.0	1.35	1.65	1.22
—	—	.631	115.4	72.8	.853	61.4	52.3	1.39	4.58	3.29
/	—	.631	116.1	73.3	.887	63.0	55.8	1.31	3.96	3.02
|	—	.631	115.7	73.0	.870	62.6	54.4	1.34	3.74	2.79
|	\	.639	116.5	74.5	.887	63.0	55.8	1.33	1.35	1.02
/	\	.648	114.7	73.5	.853	62.6	53.4	1.38	1.66	1.21

light from the Edison per unit of energy as compared with the Maxim.

The results of these comparisons in nine different positions make it possible to establish certain comparison equations, from which means may be obtained which will serve to eliminate, to some extent, the errors of experiment.

Let a = the light from the Maxim lamp 'edgewise;' then, by working through the different positions of the Edison, the above results give —

Maxim	—	a	a	a
	/	$2.77a$	$2.39a$	$2.77a$
	|	$3.58a$	$3.50a$	$3.37a$

and for means —

Maxim	—	a
	/	$2.64a$
	|	$3.48a$

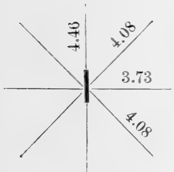
By a similar computation it is found that—

Edison	—	$4.58a$	$4.45a$	$4.36a$
	/	$3.96a$	$3.93a$	$4.38a$
	|	$3.74a$	$3.58a$	$3.86a$

the means of which give —

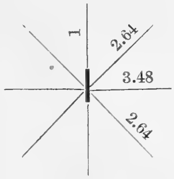
Edison	—	$4.46a$
	/	$4.08a$
	|	$3.73a$

Fig. 1.



Edison.

Fig. 2.



Maxim.

Figs. 1 and 2 show the arrangement of these intensities of illumination around the carbon filament; the plane of the filament being vertical, and Maxim edgewise being taken as unity.

For the mean all round, the result is —

$$\text{Edison} = 4.09 \qquad \text{Maxim} = 2.44$$

$$\frac{4.09}{2.44} = 1.676 = \frac{\text{E}}{\text{M}} \text{ in light.}$$

But from the previous table,

$$1.336 = \frac{\text{E}}{\text{M}} \text{ in energy:}$$

therefore $\frac{1.676}{1.336} = 1.25 = \frac{\text{E}}{\text{M}}$ *in light per electrical horse-power.*

It seems evident that this difference of twenty-five per cent in favor of the Edison lamp is largely due to the form of the incandescent filament as compared with that of the Maxim lamp. The latter shows great inequality in illumination in different directions, the light measured from the flat side being about three and one-half times as great as that obtained when the lamp is edgewise. The effect of this increased radiating surface is shown in the last column of the above table, from which it appears, that in the comparison of the Maxim, 'flat,' with the Edison in all positions, the former shows a higher actual efficiency than the latter. If this large radiating surface could be made to distribute its effect around the circumference, the lamp would, in the opinion of many, be greatly improved. It is fair to say, however, that the unequal distribution of light is claimed, by at least some of the representatives of this lamp, to be an important advantage. It was not so considered by the jury.

The form of the carbon filament in the Edison lamp is such that a much greater uniformity of illumination results. While the Maxim form has the advantage of concentrating the radiating surface, the arrangement of the carbon to accomplish this greatly diminishes its effectiveness in the 'edgewise' position. In the Edison there is but a single loop; and, furthermore, this is generally curved, so that it does not lie in one plane. As a result, one side of the loop never exactly hides the other, and there is but little loss from that source. It will be seen in the above figure that the illuminating-power of the lamp edgewise actually exceeded that in any other direction. This difference was too constant and too great to be attributed to error in experiment. It is attributable, no doubt, to the fact, that in this position the luminous lines lie nearly in the axis of the pear-shaped glass containing them, as viewed from the photometer-box; there being, therefore, less scattering of the light in transmission, and possibly some gain on account of reflection. Of course, if a lamp were used in which one of the branches of the loop exactly or nearly covered the other in this position, a different ratio of illumination might follow.

Throughout the entire series of tests the jury was fortunate in having the assistance of Mr. A. L. Rohrer, a student in physics in the Ohio state university.

In the distribution of work, Mr. Eddy and Mr. Laidlaw made the observations, and kept the records of the dynamometer work; Mr. Laidlaw also taking and reducing the indicator-cards. Mr. French made the readings of the position of the photometer-box, and set the same. Mr. Mendenhall generally read one of the galvanometers, and Mr. Rohrer the other; the latter generally keeping the notes of the electrical work, although this was done on several occasions by Mr. French and by Mr. Laidlaw.

The results of these tests seem to point to one conclusion of very considerable interest. It happened that the competition in both the arc and incandescent systems was between low electromotive force and great strength of current, on the one hand, and high electromotive force, with weaker current, on the other. In one arc system the electromotive force was almost exactly double, and the current almost exactly half, that of the other. In the incandescent systems, the contrast, although not so great, was very marked. In these trials the advantage was decidedly on the side of high electromotive force.

NOTES ON THE VOLCANIC ERUPTION OF MOUNT ST. AUGUSTIN, ALASKA, OCT. 6, 1883.[1]

On the western side of the entrance to Cook's Inlet (forty-five miles wide) lies Cape Douglas; and to the northward of the cape the shore recedes over twenty miles, forming the Bay of Kamishak. In the northern part of this bay lies the Island of Chernaboura ('black-brown'), otherwise called Augustin Island. It is eight or nine miles in diameter, and near its north-eastern part rises to a peak called by Cook, Mount St. Augustin. As laid down by Tebenkoff, the island is nearly round. The northern shores are high, rocky, and forbidding, and are bordered by vast numbers of rocks and hidden dangers. The southern shore is comparatively low.

Mount St. Augustin was discovered and named by Capt. Cook, May 26, 1778; and he describes it as having 'a conical figure, and of very considerable height.' In 1794 Puget describes it as

> "A very remarkable mountain, rising with a uniform ascent from the shores to its lofty summit, which is nearly perpendicular to the centre of the island, inclining somewhat to its eastern side. . . . Towards the seaside it is very low, from whence it rises, though regular, with a rather steep ascent, and forms a lofty, uniform, and conical mountain, presenting nearly the same appearance from every point of view, and clothed with snow and ice, through which neither tree nor shrub were seen to protrude; so that, if it did produce any, they must either have been very small, or the snow must have been sufficiently deep to have concealed them."

At that time there were native hunters, under the direction of two Russians, hunting or living in the vicinity of the north-eastern point of the island.

Vancouver placed the peak of this mountain in latitude 59° 22′: Tebenkoff places it in latitude 59° 24′.

The peak of St. Augustin is distant forty-nine miles nearly due west (true) from the settlement on the southern point of Port Graham, or, as it is sometimes called, English Harbor. This harbor is situated on the eastern side of Cook's Inlet, near Cape Elizabeth.

In connection with the fall of pumice-dust at Iliuliuk on Oct. 16, 1883, it may be of interest to observe, that the peak of Augustin is over seven hundred miles to the north-eastward of Bogosloff Island, off Unalashka (see map).

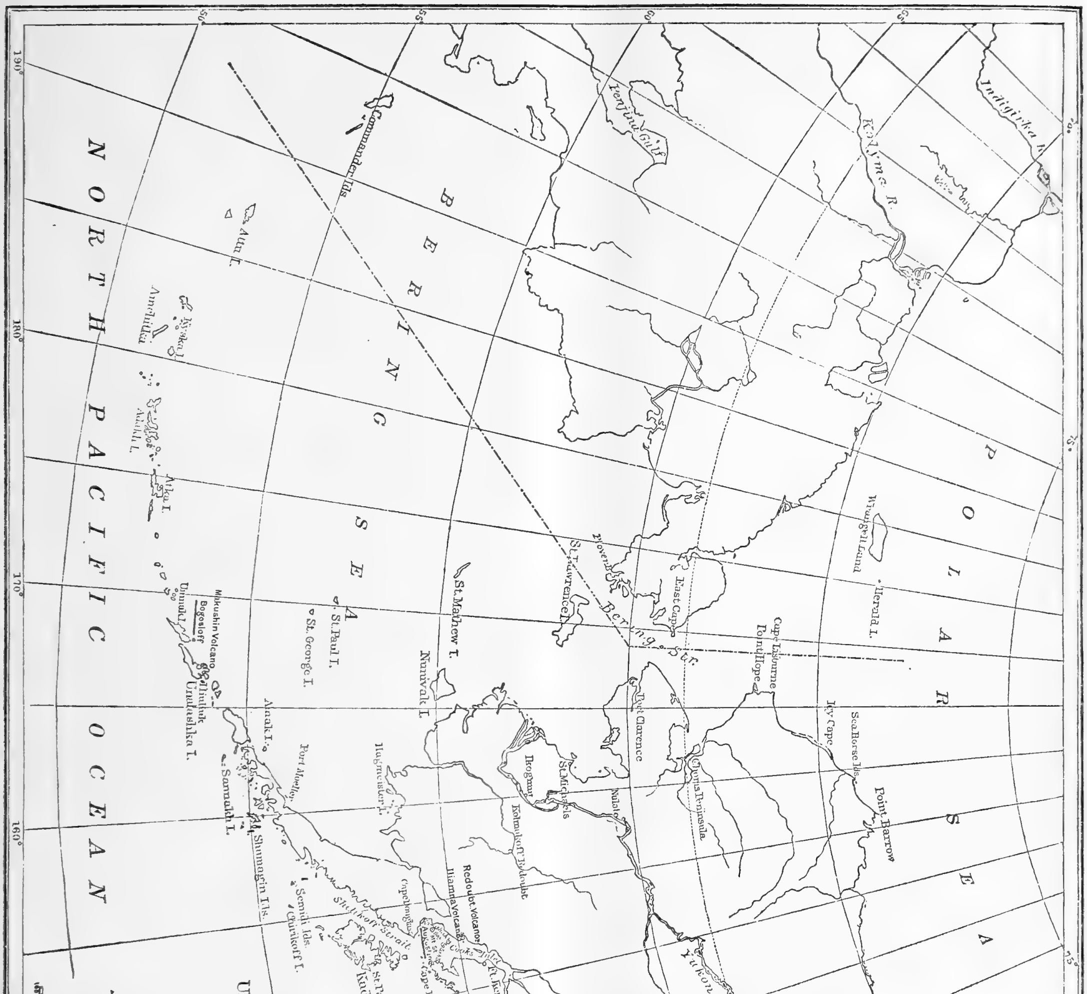
About eight o'clock on the morning of Oct. 6, 1883, the weather being beautifully clear, the wind light from the south-westward (compass), and the tide at dead low water, the settlers and fishing-parties at English Harbor heard a heavy report to windward (Augustin bearing south-west by west three-fourths west by compass). So clear was the atmosphere that the opposite or north-western coast of the inlet was in clear view at a distance of more than sixty miles.

When the heavy explosion was heard, vast and dense volumes of smoke were seen rolling out of the summit of St. Augustin, and moving to the north-eastward (or up the inlet) under the influence of the lower stratum of wind; and, at the same time (according to the statements of a hunting-party of natives in Kamishak Bay), a column of white vapor arose from the sea near the island, slowly ascending, and gradually blending with the clouds. The sea was also greatly agitated and boiling, making it impossible for boats to land upon or to leave the island.

From English Harbor (Port Graham) it was noticed that the columns of smoke, as they gradually rose, spread over the visible heavens, and obscured the sky, doubtless under the influence of a higher current (probably north or north-east). Fine pumice-dust soon began to fall, but gently, some of it being very fine, and some very soft, without grit.

At about twenty-five minutes past eight A.M., or twenty-five minutes after the great eruption, a great 'earthquake wave,' estimated as from twenty-five to thirty feet high, came upon Port Graham like a wall of water. It carried off all the fishing-boats from the point, and deluged the houses. This was followed, at intervals of about five minutes, by two other large waves, estimated at eighteen and fifteen feet; and during the day several large and irregular waves came into the harbor. The first wave took all the boats into the harbor, the receding wave swept them back again to the inlet,

[1] Communicated by Prof. J. E. Hilgard, superintendent U. S. coast and geodetic survey.


U. S. COAST AND GEODETIC SURVEY
J.E. Hilgard, Supt.
ALASKA
AND ADJOINING REGION
Statute Miles
Nautical Miles
NORTH PACIFIC OCEAN
BERING SEA
POLAR SEA
Bering Str.
Yukon River
Point Barrow
Sitka
Mt. St. Elias
Kadiak I.
Queen Charlotte Is.

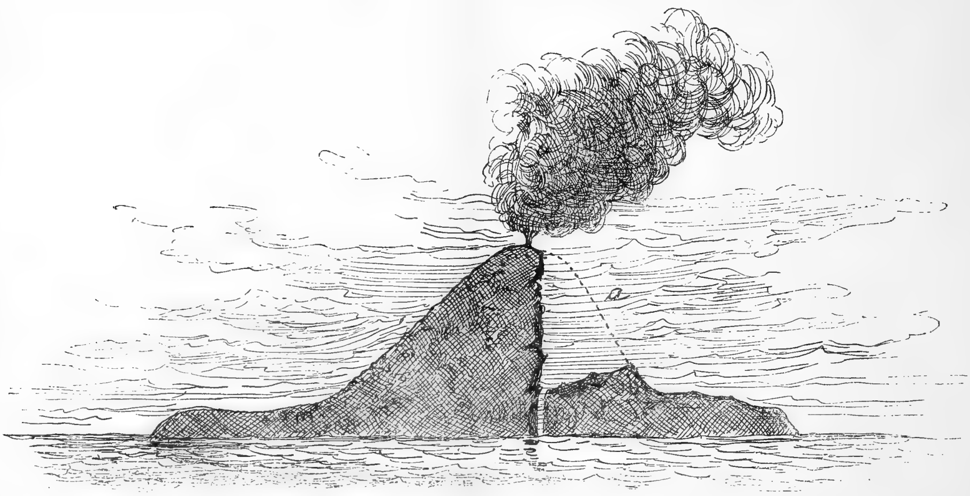
and they were finally stranded. Fortunately it was low water, or all of the people at the settlement must inevitably have been lost. The tides rise and fall about fourteen feet.

These earthquake waves were felt at Kadiak, and are doubtless recorded on the register of the coast-survey tide-gauge at that place. Also the pumice-ashes fell to the depth of four or five inches, and a specimen of the deposit was given to the tidal observer at St. Paul. It will be interesting to compare these ashes with those collected at Iliuliuk on the 16th of October, and which, from a confusion of dates, were supposed to have come from the new Bogosloff volcanic island. I am of the opinion that they came from St. Augustin.

The condition of the Island of Augustin or Chernaboura, according to the latest accounts, is this: —

At night, from a distance of fifty or sixty miles, flames can be seen issuing from the summit of the volcano; and in the day-time vast volumes of smoke roll from it. Upon nearer approach from English Harbor, it was found that the mountain had been split in two from peak to base by a great rupture extending across it from east to west, and that the northern slope of the mountain had sunk away to the level of the northern cliff.[1] This is corroborated by the statement of the hunting-party in Kamishak Bay. Smoke issued from the peak at a very short distance to the southward of the rupture.

The party of natives on Kamishak did not approach the islet, though they gave clear and distinct accounts of its eruption and subsequent appearance; but Capt. C. T. Sands, who was at English Harbor, gave the Alaska company a full description; and Capt. Cullie of the Kodiak states, that, if there were plenty of water in the line of rupture, it would be possible for a vessel to sail through (see figure). At the time of Capt. Sands's observations the low ground of the island was visible, and seemed to be a vast crater, from which smoke and flames were issuing.



MOUNT ST. AUGUSTIN AFTER THE ERUPTION, AS SEEN BY CAPT. CULLIE, Nov. 10, 1883. *a*, THE ORIGINAL OUTLINE.

But beyond all these phenomena, apart from the volcanic eruption and the rupture of the island, we have the report of Capt. Cullie of the schooner Kodiak (from whom we also obtain a statement in regard to the rupture), who approached the island from English Harbor on the 10th of November, and found that a new island, about a mile and a half long and seventy-five feet high, had been upheaved in the ten-fathom passage between Augustin and the mainland to the westward. This passage is from six to eight miles wide, and was sailed through by Puget in Vancouver's voyages of discovery.

This new island (also reported by the hunting-party in Kamishak) would appear to have arisen during the late volcanic activity. It lies to the north-westward of Chernaboura Island (Augustin), and was distinctly seen from the Kodiak, as that vessel lay ten miles to the north-eastward, and had clear weather.

To show the violence of the volcanic convulsions at this time, two extinct volcanoes on the Alaska peninsula, which are reported to be about west (true) from the active volcano Iliamna (twelve thousand feet high), had burst

[1] Capt. Cullie's account.

into activity; and during the day volumes of smoke were distinctly seen, and columns of flame at night. Usually, at that season, Augustin and the peak are covered with deep snow. On the 10th of November, however, when Capt. Cullie approached the island, while there was a depth of four feet of snow at Port Graham (English Harbor), Mount St. Augustin was bare and black.

During this same season, a party of seven or eight Aleuts had established themselves on Chernaboura (Augustin) Island to hunt the otter during the winter. Two of the women refused to remain on account of the violent noises inside Mount St. Augustin; and they were taken to St. Paul, Kadiak. Since the eruption no one of this party has been seen, nor any signs of their bidarkas, although a rescuing party of natives had gone along the coast to learn of their whereabouts. It is feared, therefore, that they have been destroyed. In confirmation of this report of the native women, Capt. Sands says that he and others noticed that St. Augustin was emitting smoke as far back as August; but no other signs were observed before the heavy report of Oct. 6.

George Davidson,
Assistant U. S. coast and geodetic survey.

THE COD-HATCHING EXPERIMENTS AT GLOUCESTER BY THE FISH COMMISSION.

In the winter of 1878 and 1879 the Fish-commission at that time having a station at Gloucester, Mass., made very extensive experiments upon the hatching of certain salt-water fish, but more especially of the cod (Gadus morrhua). For years the cod has been almost entirely confined to the deeper waters on the coast, having been driven there by many causes, sewerage being the most probable and potent; and it has been since the discovery of America that these fish, at that time extremely abundant everywhere along the shore, even to such an extent that they could be caught in great numbers from any point of rocks, have become reduced in numbers to their present comparative scarceness, and at the same time driven from their former haunts to the deeper waters. Taking into account this remarkable decrease in numbers, and change of habitat, Professor Baird conceived the idea that the former abundance of cod could in part be restored by means of artificial propagation, which had proved so successful with the fresh-water species of fish. Many difficulties stood in the way, — difficulties which had never been encountered in any previous experiments. The principal trouble which was experienced resulted from the floating of the eggs, and it was only after many trials and numerous failures that an apparatus was invented which in part prevented the eggs from clogging the screen placed over the overflow-pipe.

The location for the primary experiments was fixed at Gloucester, on account of the great industry of catching and preparing these fish, which is centred there. Vessels and boats arrive every day during the winter months, bringing in fresh cod, many of them containing spawn. By the request of the commissioner, such fish were kept alive until they could be put into the live-box at the hatchery. It was also possible, and this was the most important reason for the choice, to carry on important investigations into the natural history of the deep-sea food-fishes, and to gather valuable statistics concerning the fisheries; it being impossible to get such information in any other place.

Many obstacles arose, owing to the location. A temperature of 30° F. is fatal to cod; and, as the surface-water in the harbor is liable to reach this point at any time during two or three months of the winter, it was necessary that the car containing the live fish from which spawn was to be taken should be constantly watched, and sunk to the bottom during every cold snap. The filthiness of the water caused by decaying waste portions of fish thrown into the docks — these being common receptacles for all dirt and refuse formed by the dressing-process — was such, that, even after the most careful filtering, the water was in a decidedly impure condition. The north-east storms so prevalent on the Massachusetts coast, especially during winter, kept the water in a roiled condition for a greater part of the time; so that when it reached the aquaria, although a great part of the mud had been filtered out, still the mudiness was apparent. Such a condition could not be other than an unhealthy one for young fish whose parents had been accustomed to the clear, cool, outer waters. When there were no storms, the great rise and fall of tide, about eleven feet, sufficed to keep the finer mud in constant circulation. But, notwithstanding these numerous obstacles, over one million and a half young cod were successfully hatched, and placed in the clearer waters of the outer harbor at Gloucester. On account of the impurity of the water even there, and the adverse conditions under which they were hatched, it was scarcely expected that any

practical increase in the number of cod would be noticed as the result of these experiments. However, the results obtained proved conclusively, that if carried on under favorable circumstances, and with the experience gained at Gloucester, hatching deep-sea fish could be successfully engaged in, and made a great success. It was with this belief that an appropriation was obtained from Congress for building the extensive hatching houses and basins which are in progress of erection at Wood's Holl, Mass. Here the harbor is very pure, there being no city emptying its refuse into the immediate waters. The bottom is composed of clean sand; while the water is pure and not too cold, receiving an offshoot of the Gulf Stream, instead of the Labrador current, as is the case at Gloucester. Here the tides, although forming swift currents by the pouring of immense quantities of water through narrow outlets, rise but two feet, which is a decided advantage. Within forty miles of the hatchery, fish can be caught in sufficient abundance to supply the wants of the commission; and it is to be expected that results of great importance will be obtained by hatching and placing young food-fish in the water at various points along the New-England coast.

For at least a year, reports have been prevalent to the effect that small cod belonging to the deep-sea species have been, and are at present, very abundant in the harbor at Gloucester. In order to find out definitely, Professor Baird asked me to inquire, and collect specimens if possible, while I was at Gloucester, in October. I ascertained, that, since the winter of 1882, 'silver-gray cod' (G. morrhua) have been caught in abundance, and of just the size that the artificially hatched fish would naturally be at this time. Not only are cod obtained in the outer harbor by the fishermen, but even in the impure waters of the extreme inner harbor, where they are frequently caught by boys fishing for flounders. A specimen taken in this manner was found by Capt. Collins in the taxidermist's store, and forwarded to Professor Baird. It proved to be the true deep-sea cod. One fisherman, while obtaining bait for his lobster-pots, during the early spring of 1883, frequently caught as many as a hundred pounds of these fish in a single catch. This same fisherman informed me that at least three or four generations were plainly distinguished, the smaller being much more abundant. From only one other point along the coast was I able to find this species of cod reported in the shallow water. A school was encountered by a Gloucester vessel close in by Mount Desert, and fourteen barrels obtained. They all measured within an inch or two of fourteen inches, — just the size of those reported from Gloucester, and exactly as long as the specimen obtained from that locality. I obtained two specimens from the Mount Desert school, which are at present in the National museum. Here we find, in a limited area, great numbers of a fish now inhabiting only the deeper waters; this fish for many years having been a total stranger to the locality in which it is at present so abundant, and not found, so far as is known after many inquiries, in other similar places, with but a single exception. The oldest and most observing fishermen never remember a similar instance; and all come to the conclusion, that they are the result of the hatching operations in 1879, those from Mount Desert being but a small portion of the larger school migrating from their given home. Certainly other than natural causes must be looked for to explain this sudden increase in a small, unfavorable locality: so, as a very convenient and satisfactory explanation is found, with evidence to back it, we will say with the fishermen, 'These must be Fish-commission cod.' They will of course migrate in time; for it is hardly to be expected that they will return to their first home after once finding purer water outside.

Undoubted good must come of the future operations, for millions and millions of eggs which would otherwise be spoiled will be hatched; the young reared, and placed in the water to live and reproduce; and thus the waters will become restocked with a species of fish which is growing scarcer every year with frightful rapidity. These unexpected results of the experiments prove beyond a doubt that even deep-sea fish can be kept under control by the same means that the stock of river-fish is regulated.

While at Gloucester, Professor Farlow, by request of Professor Baird, investigated the nature of the so-called 'reddening' of salted cod, which caused such ravages during the warm months, with the idea of furnishing a remedy. This peculiar 'reddening' was found to be caused by an alga (Clathrocystis roseo-persicina) which was abundant on the marshes near Gloucester. In many of the fish-houses the alga was present in large quantities on the walls, on the flakes, and even in the vessels, probably having been introduced there by the fishermen on their clothes, or from the mud on their boots. Furthermore, it existed to a considerable extent in the Cadiz salt, which was used in preference to Trepani

salt on account of the cheapness of the former. Trepani was, on the contrary, found to contain very little. Dr. Farlow advocated that the walls and all the wood-work be scraped, and washed in hot water to kill the plant, and that painted wood be used in preference to the rough natural walls in order to afford as little room as possible for the Clathrocystis to lodge itself. He further advised that Trepani salt be used instead of Cadiz. A number of fish-dealers have adopted his suggestion in regard to the salt, and they all inform me that for two summers not a single fish has been lost by 'reddening.' The wood-work contained the plant; and in warm weather old butts turned red on the outside, while the new ones, in which no pickle made from Cadiz salt had been kept, remained perfectly intact. The fish saved by this means more than paid for the difference in price between the two salts. Trepani salt seems to prevent the rapid growth of the plant, while Cadiz rather favors it. Here, as in many other cases, we see that a little scientific thought will accomplish that which would never be brought about without it.

RALPH S. TARR.

MUSEUMS OF NATURAL HISTORY IN THE UNITED STATES.[1]

THE state of its public museums, laboratories, and other scientific institutions, gives a very reliable measure of the appreciation and culture of science by a nation. We are often inclined to consider America as a country where money-making suppresses all other interests, where learning, art, poetry, — in one word, all the finer manifestations of the human mind, — can enjoy even a poor existence only in a few places, and find in general very unfavorable ground. One, however, who has had an opportunity of carefully observing American literature during recent years, could certainly not help seeing its intellectual activity; most of all, perhaps, in the case of the sciences, they being intimately connected with practical life, and among these especially those of geology and paleontology. Most of the states created geological surveys for the investigation of the country, and the publication of maps and other results: the general government extended these investigations to the territories. The elegant publications of these geographical and geological institutions, distributed with the greatest liberality, form already a library which contains information of the greatest value concerning the vast country of the United States.

We have often enough heard that they were founding public museums in America, and that, together with their indigenous treasures, they were desirous of obtaining the material of the old world for comparison, if, as now and then happened, a valuable private collection had to make its way across the ocean. It would form a long 'list of the missing,' should we enumerate all the valuable scientific objects, which, during the last thirty years, have gone to America from Germany alone. The contributions of England and France towards the enrichment of the transatlantic museums are, of course, not less. But, in spite of all this, the American museums are hardly known among us. While among the eminent learned men of America there are only a very few who have not travelled in Europe at least once, the new world is usually not studied with the same care by the learned men of the mother-countries. The Americans, however, have begun to make their treasures in natural science accessible to the public, as well as to the specialist, in a way which in many respects deserves admiration and imitation.

The following observations on some of the most prominent museums of natural history, made during a short stay in North America, will undoubtedly prove to be incomplete, one-sided, and perhaps in many respects even inaccurate. Their main object is merely to call the attention to those institutions more carefully than has hitherto been done.

Up to the middle of this century, Philadelphia was at the head of scientific investigation in America; and even to-day, when the principal city of Pennsylvania has almost lost its leading position, a visit at the fine museum of natural history will show everywhere the traces of a celebrated past, and of a comparatively old civilization. Among all the larger museums of North America, the museum of Philadelphia shows the strongest European influence in its whole organization, and in the arrangement of the collections. The handsome building belonging to the Academy of natural sciences is in the centre of the city, near one of those beautiful squares full of trees which are the pride of Philadelphia. The first floor contains a rich library, the meeting-rooms of the academy, rooms for officials and for special investigators. The collections are in the upper part of the building, in one large hall surrounded by wide galleries. Stuffed mammals, skeletons, and several large fossil vertebrates occupy the centre of the vast room. Among them a fossil gigantic saurian, with its strong hind-legs and short fore-legs, is conspicuous by its enormous size. The bones which were found at the 'Hopkins' farm in New Jersey, and which furnished the material for the restored skeleton of the Hadrosaurus, have been well prepared, and are now kept in show-cases near by, together with the remnants of another gigantic fossil lacertian (Laelaps), and together with the nearly complete skeleton of an Elasmosaurus, found in the chalk of Kansas, which has much resemblance to Plesiosaurus. The restoration of the Hadrosaurus was made before the time of Marsh's great discoveries, and before the twenty-four skeletons of Iguanodons had been found near Bernissart in Belgium. We must therefore not too severely criticise a few errors made by the restorer in the restoration of the missing parts. By the purchase of the collection of birds from the famous

[1] By Prof. K. A. ZITTEL of the University of Munich. Translated from the supplement to the *Allgemeine zeitung* of Dec. 16.

ornithologist, Gould, Philadelphia got a first-class ornithological museum. For craniologists, Dr. Morton's collection of about twelve hundred skulls is of interest. The collection of recent shells is said to be second in completeness only to that of the British museum, and is rich in originals used in the publications of a large number of active scientific men in Philadelphia.

Through Professor Joseph Leidy, the director of the museum, Philadelphia was the first place to procure the remains of fossil mammals from the territories of Wyoming, Dakota, and Nebraska. By this excellent *savant*, attention was called to those inexhaustible treasure-houses in the far west from which, since that time, a whole world of marvellous fossil animals has been unearthed. The interest of the specialist will be attracted by Professor Gabb's collections made in California and Nevada, and by the petrifactions from the tertiary formation in Georgia and Alabama. The museum is also rich in European objects.

The interior arrangement is simple but practical. Sometimes the show-cases are rather crowded, and stand so near together that the light is not everywhere sufficient, in spite of the high windows on all sides of the hall. Already in this comparatively new building there is, as in nearly all European museums, a lack of space.

Naturalists will not leave Philadelphia without having seen Prof. E. D. Cope's celebrated collection of fossil vertebrates. During my stay in Philadelphia, this indefatigable investigator was in New Mexico in order to continue the exhumations with which he now has been occupied for many years at a heavy expense, and with much personal hardship. Very soon his elegant house in Pine Street became too small for the collected treasures, the house next to it had to be bought, and now it is filled from top to bottom with fossil bones. And again no space was left: the larger specimens, therefore, had to be placed in the cellars of a public building. Mr. Wortman, a former pupil and assistant of Professor Cope, was my amiable and well-informed guide through this improvised museum, where almost all the rooms are filled nearly up to the ceiling with cases, shelves, drawers, trunks, and boxes, where one finds piled on the floor, or along the walls, enormous skulls of mastodons and Dinocerata, or bones of gigantic saurians, and where the visitor's eyes are delighted with several complete skeletons of mammals still remaining in their stony matrix. Besides a number of forms already known by way of pictures or descriptions, one may see here the remnants of several hundred fossil vertebrates of which we in Europe know hardly more than the names. Comparing the fossil mammals of the Paris basin with those found in North America in strata of the same period, we discover a striking difference between the two faunas.

The regions of geographical distribution for vertebrates were just as sharply limited during the tertiary period as nowadays. This is the reason why we find a nearly inexhaustible abundance of new orders and species in the so-called Bad Lands of western America. Professor Cope is one of the most eminent authorities of our time in comparative anatomy and paleontology: he has bought the fine osteological collection of Hyrtl at Vienna, and is now busy in editing an extensive work, in which he intends to give descriptions, as well as pictures, of the numerous fossil mammals discovered by him.

While Philadelphia has the oldest museum of North America, Washington is arranging the newest one. In the elegant, beautifully situated capital of the country, with its wide and clean but hardly animated streets, with its vast parks and magnificent edifices, the visitor will be surprised to find unfinished, not only the Washington monument, but also various other edifices. But if once all the enterprises which are now going on are finished, Washington will be one of the most beautiful cities of the world. Not far from the simple home of the President there is a park of about fifty acres, in which we find most imposing public buildings, among them the greenhouses of the botanical garden, the Smithsonian institution, and the National museum. The latter is in a palace of red sandstone. The interior of the tasteful building, in Normano-Gothic style,[1] contains in the centre a dome-like hall two hundred feet long, where various collections in a somewhat strange mixture are accommodated. Large glass cases with stuffed animals are put together with Indian curiosities, models, and relief-maps, together with samples of building-materials and ores. Part of the hall and a wing of the building are given to the geological survey. In the other wing we find the excellently arranged prehistoric and ethnographical collection, under the direction of our countryman Karl Rau. The great variety of the tools and weapons made of stone, still used among some Indian tribes, which are exhibited here, is hardly less remarkable than the ability with which these savages work the brittle material. In this respect the American autochthones have undoubtedly attained a higher civilization than the inhabitants of Europe during the stone period. For the present, the National museum, as a whole, can be considered merely as the beginning of a museum of almost universal character; but, with the enormous means which are at the disposal of the central government, it needs only a few influential and energetic men to develop great things out of this promising germ.

A glance at the growth of the American museum of natural history in New York shows what energy, and readiness to sacrifice, may accomplish within a few years. In January, 1869, a few scientific friends met, and decided to found in New York, the metropolis of North America, a museum of natural history, which was to correspond with the means and the importance of this city, and to give its inhabitants an opportunity for recreation and instruction. Within a few weeks forty-four thousand dollars were subscribed. Out of this money the collection of birds made by Prince Maximilian of Wied was bought. Many other objects were given; and very soon the

[1] The writer has here confused the Smithsonian and museum buildings.

halls of an armory, assigned by the city to the museum, proved to be too small. Thereupon the trustees thought of having a home of its own for their collections; and to that end the city government not only gave Manhattan Square, an estate of eighteen acres and a quarter, in the immediate vicinity of Central Park, but also decreed the necessary means for the projected building.

In June, 1874, the corner-stone was laid, in the presence of President Grant, the governor of the state, the mayor of the city, and a number of prominent persons from Boston and New Haven. As early as December, 1877, the large fire-proof building, consisting of nothing but stone and iron, was finished so far that it was possible to transfer the collections, and to make them accessible to the public. To-day the museum is already filled to such an extent, that the trustees ask for three hundred thousand dollars more, in order to put up an additional building of the same size. In regard to the excellent adaptation of the building to its purposes, and also in regard to the practical interior arrangement, the New-York museum deserves to be called a model institution. The exterior of the red-brick building is without any ornamentation. The entrance at the narrow side leads to the basement: the large staircase is opposite. Each floor contains, besides one single large hall of a hundred and seventy by sixty feet, only a few small laboratories near the stairs. Wide and high windows on both sides furnish plenty of light. Between them the walls have openings like loopholes, through which the interior of the cases, which are in a rectangular position against the side-walls, get the necessary light. The wide, well-ventilated halls, provided with heating-apparatus and gas, make a grand impression. On all the floors the main cases are arranged in the same way, and are of the same size; so that it would be easy to move the contents of one hall into another. The rooms, as well as the cases, are well protected against dust. The cases are made of iron; their doors, of a single pane of glass. The tasteful and appropriate furnishings correspond with the contents. In the basement there is a rather small collection of mammals. We do not see here those shabby skins, half-destroyed by moths, nor those ill-shaped, four-legged straw bags which disfigure so many museums of older date. Every thing is new and clean; and some groups — as, for example, the family of orang-outangs, or the Ornithorhynchus, with its surroundings — may well be called pictures borrowed from nature. The collection of birds on the first floor deserves similar praise. The laymen will be pleased with the birds of paradise, the macaws, the parrots, and the humming-birds, which display here the beauty of their feathers. The hall of the first floor is thirty feet high, with a wide gallery, forming, so to speak, a floor for itself, with its own windows. Here we find a rich ethnographic and prehistoric collection. American objects predominate; but there is no want of foreign material for comparison, and especially one interested in the European stone period could find here very many valuable things. The next floor contains the geologico-paleontological and the mineralogical collection. The nucleus of this division is a collection bought for sixty-eight thousand dollars, from Prof. J. Hall in Albany, the Nestor of American geologists. The typical objects, as given in Hall's voluminous work on the state of New York, are arranged here in a way that affords an excellent view of the whole; and I do not think that the enormous mass of paleozoic petrifactions of America is better exhibited in any other museum. On the highest floor there is a library, a hall for public lectures, laboratories, and a number of rooms for various specialists and their private collections. A freight-elevator runs from the cellar to the highest floor in an American museum, as a matter of course.

If we consider what has been done in New York within less than fifteen years, we have, indeed, to admire the energy of the superintendent, Prof. A. S. Bickmore. He not only knew how to get some of the richest and most influential citizens interested in his work, but also formed, with the means at his disposal, an institution unrivalled in many respects. The American museum of natural history is open to the public daily; and, on an average, about fifteen thousand persons a week make use of this privilege. The city of New York pays to the museum annually fifteen thousand dollars. All the expenses above that are paid by subscription. Should the plan, as exhibited in the basement, be carried out, the museum wolud have twelve buildings of the size of the present, which, together with six connecting wings, would cover the whole of Manhattan Square. An enormous cupola would form the centre of the whole. Then New York would decidedly have the largest museum of natural history in the world.

The museum of the state of New York, at Albany, is on a smaller scale. This institution has been founded by the celebrated geologist, J. Hall. During fifty years of investigation he has unearthed the geological and paleontological treasures of his state; and, besides a private collection, he has created a public museum, where the products of the state of New York are exhibited in a fine arrangement. In Germany we have only one local collection, the 'Württembergisches landes museum,' at Stuttgart, which is ahead of the museum of the state of New York in regard to arrangement and completeness.

For study and investigations, the capital of the state of New York, with its unpleasant political life, is not a very favorable place. The university towns of New Haven and Cambridge are far better homes for intellectual culture in North America. There is no better introduction into society than a diploma from Yale or Harvard. These universities are partly imitations of English colleges, partly of German institutions; and for decades there have been first-class learned men among their teachers. The scientific life of America is under the influence of these universities and these independent corporations are so popular that they receive considerable legacies nearly every year. The numerous handsome buildings of Yale college at New Haven show the wealth of this institution. Among the simple dormitories and buildings for lecture-rooms, the museum of

natural history attracts the attention by its height and a fine Gothic front. It owes its existence to a gift of Peabody, the well-known philanthropist. The first story is occupied by a collection of minerals most excellently arranged, by the private laboratories of Professors Dana and Brush, and by lecture-rooms and common laboratories. The middle floor contains the geological and paleontological collection. The highest floor contains collections for zoölogy and prehistoric ethnography.

The centre of interest at New Haven is a collection of fossil vertebrates founded by Prof. O. C. Marsh. Not only the whole first story, but also cellar and attic, are filled with fossil bones. Long rows of piled-up boxes contain the paleontological treasures. Only a very strict order makes it possible to find every thing in these crowded rooms, where a number of assistants are busy in preparing and combining the objects which so often arrive in fragments. In a small additional building a German modeller forms casts of the finest specimens, and afterwards these casts are sent with the greatest liberality to American and foreign museums. To a large extent, the Peabody museum owes its fine condition to the self-sacrificing activity of Professor Marsh.

What at the beginning of this century Cuvier did in Europe for the knowledge of antediluvian vertebrates, has been done in America by Professor Marsh, and his not less active rival Professor Cope in Philadelphia. The great variety of fossil vertebrates in America corresponds with the vastness of the country. Whole cartloads of bones have been dug out in the Bad Lands of the far west: they were carried on the backs of mules hundreds of miles, before they reached the railroads which brought them eastward. For months Professor Marsh and his assistants were camping in the reservations of the Indians, protected by an escort of cavalry. With the great chiefs of the Sioux, 'Red Cloud,' 'Red Dog,' he used to smoke the pipe of peace: against others he had to defend himself, revolver in hand. Professor Marsh's collection of fossil remains of vertebrates, brought together within about fifteen years, is not less complete, and not inferior in value to the collection of the British museum in London. It is infinitely more than all the material ever seen and studied by Cuvier during his whole life. During my visit at New Haven there were about twenty-five gigantic skulls of Dinocerata in the professor's laboratories. Several lithographers were occupied in making plates for the publications in which the fossil mammals and reptiles of America will be described. In an adjoining room a whole series of teeth, and bones of the foot, illustrate the development of the horse species. Though the Indians made the acquaintance of the horse only through the Spanish 'conquistadores,' there is no country where remains of antediluvian horses are so often found as in America. A series of fossil species shows the changes which the ancestors of the horse underwent, before the present type of the solidungulate was attained. Europe, also, has some of the intermediate forms, but not so many. The American predecessors form a nearly uninterrupted series. From the enormous mass of antediluvian mammals I can mention here only the oldest forms from Jura and tertiary strata, which have been discovered lately in America. Up to that time we knew only several lower jaws found in England, and a few teeth from the keuper of Wurttemberg.

Professor Marsh has brought from Wyoming remnants of at least three hundred specimens, and not only lower jaws, but also skulls, and other parts of the skeleton. They belong, without exception, to little marsupial-like species, usually of the size of a rat or squirrel. In contrast with these dwarfish forms, the reptiles of the Jura and chalk formations excel usually by their gigantic size; and it is just the largest and the clumsiest of them that show a remarkable combination of reptilian and avian peculiarities. New Haven has the largest collection of such dinosaurians. There you may see a complete skeleton of the curious Brontosaurus, — an animal with a small head, a long neck, long tail, high hind-legs, and short fore-legs.

The upper part of the femur of the gigantic Atlantosaurus is about twice as long as the corresponding bone of an elephant. The curious Stegosaurus, thirty feet long, was covered with an armor of enormous bone plates, and armed with thick spines. The cavity of its brain was of a minimum capacity; but, in compensation therefor, the spinal marrow in the os sacrum is swollen into a second brain-like enlargement. Another little saurian (Coelurus) has ring-shaped vertebrae which are entirely hollow. Hadrosaurus has shining teeth, jagged on the sides like shark's teeth, in several rows above each other, and side by side, so that they come into use only one after another. Besides these dinosaurians, some snake-like saurians of the sea, with short swimming-feet (Mosasauridae), attract our attention. A slab three metres high contains a complete well-preserved skeleton of such an animal. On the whole, Professor Marsh may have parts of about sixteen hundred specimens.

America has also flying saurians; though the skeletons are not often so completely preserved as those in the lithographic slate of Bavaria, but they are of considerably larger size. The skull of a Pteranodon, for instance, is three feet long. While this flying saurian differs from its European relatives by toothless jaws, there are in the chalk strata of America a number of birds with well-developed teeth. Professor Marsh has given a description of these curious creatures in a very elegantly executed monograph.

A visit at the Peabody museum, under Professor Marsh's guidance, arouses very mixed feelings in a European colleague. Together with sincere admiration, he necessarily has the disheartening conviction, that, whereas the time of great discoveries has begun in America, it is over in Europe. The character of greatness and magnitude which we find in many conditions of American existence is also prominent here. Compared with the paucity of the discoveries in our own country, the virgin soil of America furnishes, uninterruptedly, new and unexpected objects

It is beyond question that the future development of geology and paleontology will be essentially influenced by America; but it seems to me, that, for zoölogy also, a model institution for the future, in many respects, has been created in the celebrated Agassiz museum in Cambridge, near Boston, which probably will not be without influence on the development of museums of natural history in Europe. On an extensive plot near Harvard university there has been erected a five-story brick building with numerous windows, but with no ornamentation, and with an almost barrack-like appearance. The simple staircase corresponds with the modest exterior and with the whole interior arrangement. The genial founder of the 'Museum of comparative zoölogy,' as he called it, did not intend to have a brilliant exhibition, but a place for serious labor and study. And the great enterprise called into existence in 1860 by Louis Agassiz has now been nearly completed, according to the ideas of the father, by the energy and the organizing talent of the son. Over three hundred thousand dollars were subscribed in a short time, when Louis Agassiz, twenty-four years ago, came to America, and announced a plan for the erection of his museum. Nobody knew better than he how to arouse the enthusiasm of others for ideal purposes by the power of words; and we may well say that he originated that new movement in the descriptive natural sciences which continues up to the present day. A whole school of young zoölogists grew up at Cambridge. Collections of all kinds were bought in the old and in the new world, expeditions were sent to far-away countries, and the depths of the sea were investigated. The ingenious investigator, who was always full of new ideas, had neither time nor patience for the sifting and arrangement of the extremely rich material: his son and successor undertook this task. As an administrator, Alexander Agassiz may be equalled only by a few; as a naturalist, he belongs, as his father did, to the first names of America. A large fortune, acquired in the copper-mines of Calumet and Hecla, near Lake Superior, makes it also possible for him to promote the interests of the museum financially. To him it must be attributed, that the museum has been entirely withdrawn from the influence of an often-changing government, and has been transferred to Harvard university.

In the well-lighted basement of the museum there are eight rooms assigned to the collections in alcohol, which consist not only of lower animals and fishes, but also of numerous mammals, birds, and reptiles in metal boxes filled with alcohol. A seawater aquarium, a room for the preservation of living animals, and various other storerooms, occupy the rest of the basement.

On the first floor, there are the paleontological and geological collections, together with the necessary laboratories and lecture-rooms. The parts of the collection devoted to scientific investigations are separated from the collections for the show-cases proper; and in those, only a comparatively small selection of objects is exhibi ed. The second floor contains the rooms of the curator, a rich library, laboratories for anatomical and physiological investigations, and other workrooms for more advanced students and specialists. Besides the rooms already mentioned, there is on each floor a so-called synoptic room, through which every visitor of the museum has first to pass. A small but well-selected collection gives here a general view of the most important representatives from all classes of the animal kingdom. Large inscriptions on the walls and on the cases make it easier to find one's way. All the specimens are accurately labelled. Dissected preparations explain the anatomical structure of crabs, insects, echini, starfishes, etc. The synoptic room for zoölogy may well be called a model of a collection for purposes of instruction. A similar collection for geology and paleontology is in preparation.

While the two lower floors are chiefly devoted to purposes of instruction, the specialist will find in the three upper stories abundant material for his investigations. The third floor contains a zoölogical collection accessible to the public. In five halls all the more important species and varieties are exhibited in systematic order, and not crowded together. For the vertebrates the stuffed skins, as well as the skeletons, are given.

The zoögeographical collection is a specialty of the Cambridge museum. In two well-lighted halls one finds the whole fauna of America. The typical specimens of the animal kingdom of Africa, of India, of Europe and Siberia, and of Australia, are represented in their respective rooms. A special hall has been reserved for the inhabitants of the ocean; and here it is intended to place the rich treasures acquired by the investigations of the depths of the American seas. Most probably several years will pass by before the arrangement of this extremely interesting division of the museum will be finished, — a collection which will be unique in its way.

In the two highest stories the large and strictly systematic main collection of geology is stored in simple but appropriate cases with glass doors. Thousands of skins of mammals and birds are stored up in drawers. The lower animals are deposited in a similar manner. Every case and every drawer bears a label showing its contents. In many departments Cambridge is said to be even ahead of the British museum. Excellent methods of preparation have been applied with fishes and reptiles. The collection of insects, under the direction of the German entomologist, Dr. Hagen, excels by reason of its abundance of beautiful preparations, showing the whole development of the more important species and varieties.

By a mere hasty visit to the exhibition-rooms no one will get an idea of the magnificence of the Museum of comparative zoölogy. Neither the building, nor the rooms inside, nor the exhibited objects, will make an especially imposing impression. But the strong point of this institution lies in the peculiar arrangement of the collection for the public, and in the strict separation of the large material for scientific investigations. By the constant development of science, by the improved accessibility of distant continents

and islands, by the investigations of the depths of the ocean, collections of natural history will be enlarged almost to infinity; and it will be harder and harder to place them in our museums, and to preserve them. Everywhere buildings begin to be insufficient; and if we were to stick to the old system, according to which a museum exhibits nearly all its objects, the large central depositories of natural history would grow to an enormous extent. The organization of the Cambridge museum tries to meet equally the demands of science and the wants of the public which comes for information; and in this sense I have called the Agassiz museum a model museum for the future.

Besides the institutions here mentioned, there are in many other cities of the United States — as Chicago, San Francisco, St. Louis, Cincinnati, Princeton, Baltimore, Charleston, Providence, etc. — smaller museums of natural history. They are almost all supported by societies or schools. There is, therefore, no lack of interest in scientific studies; nor is money wanting. But still the number of those is very small, who, out of pure enthusiasm for science, prefer the modest existence of a learned man to a materially better-paying occupation. In this respect Europe is still far ahead. Circumstances, however, will change, together with the great development of North America; and in some of the Eastern States an alteration can already be noticed. We must therefore keep our eyes open, if we do not wish the experience of having our young cousins across the ocean outstrip us in a field the thorough culture of which, so far, has been the glory of old Europe.

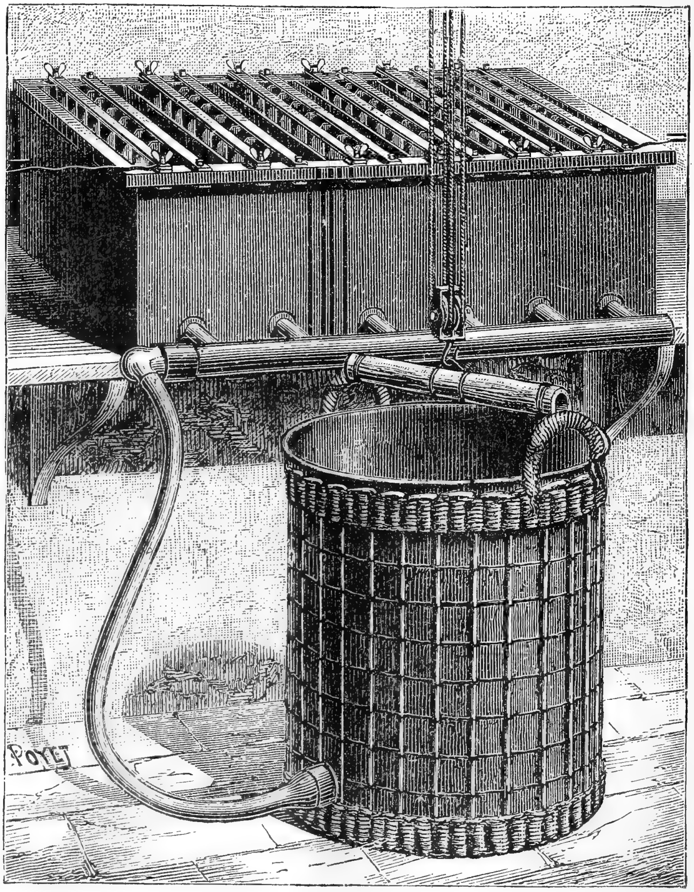


FIG. 3.—Batteries for Tissandier's balloon.

TISSANDIER'S ELECTRIC BALLOON.[1]—II.

As we have described our apparatus as a whole, we will now give some details concerning the various parts, and especially concerning the dynamo-electric motor and the bichromate of potassium battery, which was prepared with a view to our experiments.

The motor is a Siemens new model machine, made at Paris especially for us, consisting of a bobbin very long in proportion to its diameter, and mounted on a light wood frame. This machine weighs only fifty-

[1] Concluded from No. 53.

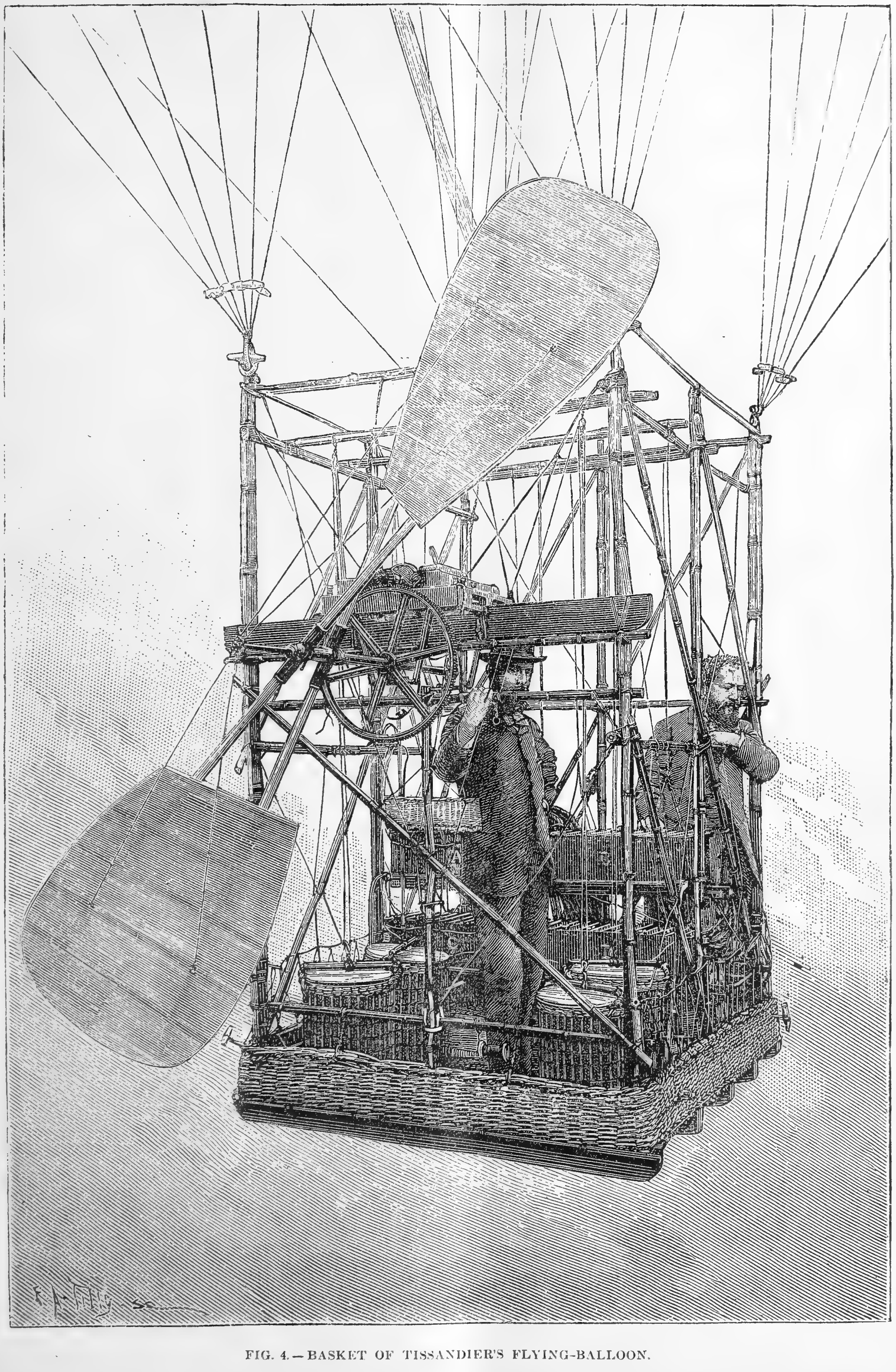


FIG. 4.—BASKET OF TISSANDIER'S FLYING-BALLOON.

four kilograms. The screw consists of two helicoidal pallets covered with varnished silk, the deformation of which is guarded against by the action of coils of steel wire. This screw is 2.85 metres in diameter: it is attached to the machine by a transfer and by gearing, and makes a hundred and eighty revolutions per minute, while the bobbin makes eighteen hundred.

The electric battery, which may be called the generator of the screw balloon, has the same surface of zinc and carbon as our trial batteries, the measurement of which has already been given elsewhere (*La Nature*, May 20, 1882), the same number of cells, the same volume of liquid. We are able to considerably reduce its capacity by using four ebonite troughs with six compartments, instead of twenty-four separate receivers. Besides, we use slightly higher vessels, which also gives greater breadth. Fig. 3 presents one of the four batteries used in the electric balloon as it was tried in the laboratory. It consists, as may be seen, of one large trough with six divisions; each compartment forming an element of the pile, enclosed and mounted on copper legs, having eleven thin carbons and ten zincs arranged alternately. The zincs are held in place from above by flexible pincers, and may easily be renewed after each experiment: they are .15 of a centimetre thick, sufficient to work the battery for three hours. They must be perfectly amalgamated. Each compartment is provided at its lower part with a slender ebonite tube, which communicates to a lateral conduit connected by a caoutchouc tube with a large and very light ebonite vessel containing the acid solution of bichromate of potassium. If the pail is raised by means of a string passing into the blocks above the level of the battery, the latter is filled by the chief communicating vessel, the liquid acts on the zincs, and the current passes: if the pail is lowered, so that it occupies the position seen in fig. 3, the liquid enters by the caoutchouc tube, the battery becomes empty, and ceases to act. By this system it is apparent that the piles communicate with each other solely by the narrow conduits. The resistance of the liquid is great enough for this communication to have no effect on the current, although the elements are in series. In the car there are four batteries like that shown in the figure, of twenty-four elements, in series, and fed by four pails of ebonite, each containing thirty litres of the bichromate of potassium solution. The batteries are stowed away in the car (which is 1.9 metres long and 1.45 metres broad) so as to occupy the least possible room. Two ebonite troughs of twelve elements are placed cross-wise about .35 of a metre from the bottom of the car, and there are two more .15 of a metre higher. The ebonite reservoirs at the two back corners of the car feed the upper piles; and the other two reservoirs, nearer the battery, feed the lower piles (fig 4). A vacant space is left between the four pails for the operator, who controls every thing, having at hand the cords to raise the pails, the hooks to hold the cords at the desired height, the commutator with the cup of mercury to start the current, and the cords the rudder.

The bichromate of potassium used to work the battery is concentrated and very acid: it is turned into the pails at a temperature of about 40°, which permits of a considerable increase in the quantity of dissolved salt. The commutator is so arranged that a current of six, twelve, eighteen, or twenty-four elements may pass; and thus the screw has four velocities. The four pails are covered with a sheet of caoutchouc, pierced with one small hole, which allows the air to pass when the liquid is flowing, and is bound around the pail by a copper thread sheathed in gutta-percha. This manner of closing is very secure; and, in case of a shock, not a drop of the liquid can escape. The pails, when empty, weigh only three kilograms each: they are strengthened by basket-work, which also serves as a support. Cords passing into the pulleys raise them above the piles in order to fill them, and lower them to empty them. The bottom of the car holds a caoutchouc cistern to receive the liquid in case of accident. The pile with the liquid weighs about a hundred and eighty kilograms. A little willow basket — easily seen in our illustration — is placed under the motor. It contains an oil-can for the motor, a little bottle of mercury to supply the cups of the commutator sunk into a block of box-wood, and also the tools necessary to discharge the pile in case of accident. All this occupies the back of the car. In the front, space is reserved for the ballast-bags and for the implements used in the descent.

Our illustration was made with great exactness: it presents all the details of the arrangement of the car, and shows the attachment of the motor. The

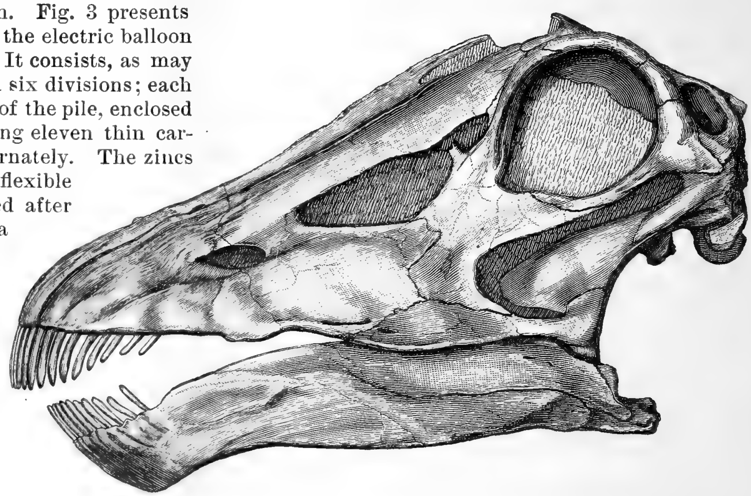


Fig. 1. — Skull of Diplodocus longus Marsh, side view.

Siemens machine, and the spring which it works, are arranged on a walnut cross-piece. In addition, it is held by stretched ropes, which may be tightened at pleasure by tension, and which connect the four extremities of the framework with the upper and lower cross-pieces of the car. When rotating with great velocity, the vibrations are avoided by this method of attachment.

The use of such a machine in the car of a balloon is comparatively simple. When every thing has been prepared on the ground, there is nothing to do but to plunge a little copper fork into the mercury-cup of the commutator, and the screw begins to turn.

From fear of fire, and from the change of position, which affects the altitude of the balloon when once poised in the air, the operator must have no manual work to do: electricity alone supplies all the fundamental conditions of the aerostatic motor-force. After the winter, when favorable weather comes, the first electric balloon will again take its flight.

GASTON TISSANDIER.

A NEW AND STRANGE DINOSAUR.

PROFESSOR MARSH continues his studies of the Jurassic dinosaurs of America by giving, in the last number of the *American journal of science*, an account of a new family of Sauropoda founded upon the genus Diplodocus, which he places between the Atlantosauridae and the Morosauridae. The chevrons of the caudal vertebrae, which have both anterior and posterior branches, have suggested the name Diplodocus; and the ischia of the pelvic girdle are intermediate in form and position between the families heretofore recognized, the shaft being straight, and not twisted nor apically expanded.

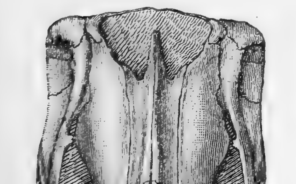


FIG. 2. — The same skull, front view.

But the best preserved portion is the skull, of which we reproduce Professor Marsh's excellent figures. It was of moderate size, the figures being one-sixth the natural size, and showing clearly the characteristic features. It has two pairs of ante-orbital openings, the small front pair not having been seen before in dinosaurs. The brain inclines backward, and has a very large pituitary body, enclosed in a capacious fossa below the main brain-case, — a very different condition from that holding in the other families of Sauropoda. The size of the skull indicates an animal probably forty or fifty feet long: the weak dentition shows that it was herbivorous, and its food was probably such succulent vegetation as an aquatic life would enable it to procure.

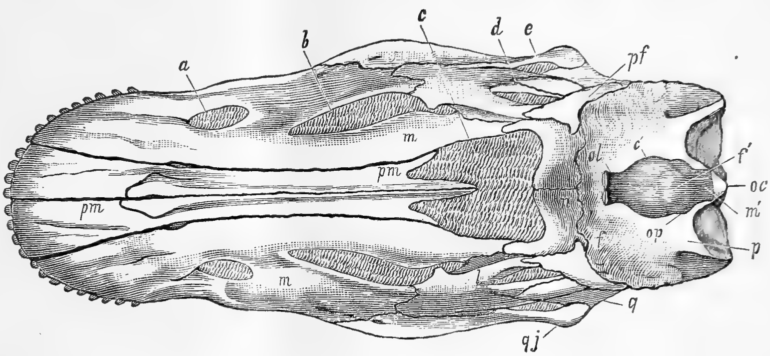


FIG. 3. — Skull and brain cast of the same, seen from above. *a*, aperture in maxillary; *b*, ante-orbital opening; *c*, nasal opening; *c'*, cerebral hemispheres; *d*, orbit; *e*, lower temporal fossa; *f*, frontal bone; *f'*, fontanelle; *m*, maxillary bone; *m'*, medulla; *n*, nasal opening; *oc*, occipital condyle; *ol*, olfactory lobes; *op*, optic lobe; *p*, parietal bone; *pf*, pre-frontal bone; *pm*, pre-maxillary bone; *q*, quadrate bone; *qj*, quadrato-jugal bone.

In looking at these figures, and noting their strange resemblance to a horse's skull, one finds it hard at first to recall the fact that the nearest living allies of Diplodocus are the crocodiles.

THE FALSE PROPHET OF THE SUDAN.

THE religious movement in the Sudan has a special interest for ethnologists on account of its parallelism with the events by which the faith of Islam was originally propagated. A recent letter from Khartum informs us that Mohamed Ahmed, the Mahdi, was born at Dongola in the year 1260 of the hegira. His parents, Abdellahi and Amina, were poor, and had two older sons. From the age of seven he was taught in a Mussulman school to read, write, and commit to memory the Koran. At the age of twelve he knew the latter perfectly. In the same year his father died; but his brothers continued his education while he pursued studies of the Mussulman law, foreseeing eminence in store for him. After the death of his mother, having completed his studies, he repaired to the Isle of Aba on the White Nile, to be near his brothers, who were boat-builders. For nearly fifteen years he inhabited the isle, venerated as a holy man by all who knew him, before making claim to the title of Mahdi or Mussulman Messiah. He then wrote to all sheiks and grand dervishes of the region, that the prophet

Mohamed had appeared to him in a dream, and informed him, as from Allah, that he was the long-promised Mahdi; that the Turkish supremacy was at an end, the reign of the Mahdi begun; requesting their assistance, and further predicting wars and insurrections for the Sudan. For himself, at the proper time, he proposed to go to Mecca to receive recognition from the grand sheriff. These predictions were circulated at Khartum a year before they came to the knowledge of the local authorities. Finally Raüf Pasha, governor-general, decided to send a deputation, headed by the famous Abu Suüd, to confer with the new prophet. The latter was found in a large hut surrounded by his dervishes, but declined to go to Khartum or to perform miracles, the time for which, he said, was not come. Abu informed him that he would be forcibly taken to the governor if he did not come willingly; but, discovering several men with drawn swords in his rear, he retreated precipitately to his despatch-boat and to Khartum. He was sent back with two hundred soldiers, commanded by an adjutant-major, to bring the Mahdi forcibly. These soldiers landed at night in mud up to their middles, lost all courage, and, arriving at the hut, were confronted by a mob of whirling dervishes. One of these was shot by the commander as a signal for attack, when the remainder, with thousands of Arabs who had remained in ambush, threw themselves upon the little troop, and exterminated them. The boat was next attacked, and was obliged to retreat to Cava. On the 20th of August, 1881, a large force was collected at Cava to crush the insurrection before it gathered strength. Meanwhile the Mahdi and his people left the Isle of Aba under the very eyes of troops who dared not oppose him, and made his way toward the mountains of Gadir. Here, in November, 1881, he was attacked by Rashid Bey and the king of the Shiluk tribe with five hundred soldiers, who were destroyed, almost to a man, in a few moments as it were. Raüf Pasha being superseded, Giegler Pasha, a European civil officer temporarily in charge, declared that he could preserve order with the troops at his command, and declined re-enforcements. In order to carry out this boast, he concentrated the garrisons of Kordofan, Kashoda, Sennaar, and Khartum, and despatched them from the latter place against the Mahdi, under command of Yusuf Pasha. They comprised about seven thousand men, mostly untrained conscripts, with six cannon.

Three days after their arrival at Gadir they were attacked by fifty thousand insurgents, commanded by the brothers of the Mahdi; and only about a hundred and twenty-four private soldiers escaped from the general massacre. The troops of the Mahdi suffered severely, and both his brothers were killed. Meanwhile the other provinces, from which the garrisons had been withdrawn, began to rise against the authorities. Sennaar revolted: the few soldiers there were slain, with all the Europeans, and their goods looted. El Kerim Bey came to the rescue of the government with three thousand Arabs. He was killed, his men slain or dispersed, his villages were burned, and all the inhabitants put to the sword, without regard to age or sex.

At this juncture Abdelkader Pasha was named to the governorship; and the Mahdi marched on El Obeid, capital of Kordofan, putting the inhabitants of the villages on his way to the edge of the sword. A Catholic mission, consisting of two priests, two sisters, and two lay brothers, were taken prisoners by the Mahdi, and tortured for three days, in a vain attempt to force them to renounce their religion. In September the Mahdi attacked El Obeid with a hundred and ninety-two thousand insurgents. Assisted by a trench, the defenders held their ground for two hours, after which the Mahdi retired, leaving twelve thousand of his men on the battle-field. He proceeded to invest the town, and in four months and a half reduced it by famine, on Jan. 17, 1883. All the Europeans were obliged to embrace Islamism to escape death. Their goods were confiscated. The mission was demolished; the missionaries, male and female, put to the torture. The archives were burned; the merchants of the town, and all the principal functionaries, sold into the interior as slaves. The females suffered rapine.

Before this, thirty-seven hundred soldiers, commanded by Ali Bey, had been sent to succor El Obeid. They were attacked by thirty thousand insurgents under Mama, the grand-vizier of the Mahdi. A thousand escaped to Bara, where they capitulated to the rebels two weeks before El Obeid. But the career of victory was not wholly unchecked. Karkodi on the Blue Nile, the headquarters of the trade in gum and lentils, was captured by the rebels, and partly burned. Four hundred soldiers and merchants were massacred. However, in thirty-five days, the rebels were driven out by the Egyptian troops, and order re-established. A revolt on the White Nile at two large villages, ten hours from Khartum, was crushed, with heavy loss to the rebels, and the death of their leader and his three sons.

Up to this time the insurrection had cost more than a hundred thousand lives in the Sudan. At the time this letter was written, Hicks Pasha and his army were just arrived, and were expected to restore order. Their rout and massacre occurred later. At this date the Egyptian government, under pressure from England, is about to abandon the Sudan to the hordes of the Mahdi; and the unfortunates who are holding a few outposts in the faith of rescue will be left to their fate. The story reads like a page from the middle ages; and it seems hardly credible that such events can characterize any part of the nineteenth century. Unless the strong arm of Abyssinia intervenes against the forces of the false prophet, it is quite possible that even for Egypt proper the end is not yet.

THE GEOGRAPHISCHES JAHRBUCH.

Geographisches jahrbuch. Vol. ix., 1882. Gotha, *Perthes*, 1883. 16 + 719 p. 12°.

THIS *jahrbuch*, an outgrowth of Petermann's *Geographische mittheilungen*, was first pub-

lished in 1866, under the editorship of E. Behm. On the death of Petermann, in 1878, Behm took charge of the *Mittheilungen*, and H. Wagner succeeded him in the preparation of the *Jahrbuch*, of which the ninth biennial volume has recently been issued. It is about double the size of the first number, and, as now conducted, covers a broad field in geography and allied departments of study, as the following abstract of the contents will show. Indeed, the range of topics reported upon by the thirteen specialists who aid Wagner in its preparation is now so extensive that the seven hundred pages of the present volume are no longer sufficient to contain abstracts of all of the three thousand papers quoted.

The more directly geographical part of the volume contains chapters on the exploration of Africa (42 pages), Asia (35), the polar regions (27), and the oceans (25), by Zöppritz and Lullies of Königsberg, Wichmann of Gotha, and v. Boguslawski of Berlin. From the last of these, we may note the following maps, as embodying the present state of our knowledge concerning the form of the sea-floor. An atlas of thirty-six maps, showing the physical relations of the Atlantic Ocean, was published in 1882 by the German 'Seewarte' at Hamburg. Its first plate shows the depth by eight contour lines at two hundred, a thousand, two thousand, etc., to seven thousand metres, the old fathom measure being discarded. The northernmost Atlantic and adjoining Arctic Ocean are represented in the maps by Mohn, published in supplement No. 63 to Petermann's *Mittheilungen* (1880). The Indian Ocean and the several seas between Asia and Australia are shown in two maps by Krümmel in Kettler's *Zeitschrift für wissenschaftliche geographie* for 1881 and 1882. The latter is especially valuable in illustrating the distribution of temperatures in the sea.

A very considerable share of the work is allowed to questions not simply geographical. Geological investigation is reviewed by v. Fritsch of Halle in seventy-one pages; but only three of these are allowed to the United States, showing a decided inequality of treatment. Studies on the distribution of plants (83 pp.) and animals (71 pp.) are summarized by Grube of Dresden and Schmarda of Vienna; and Gerland of Strassburg reports on ethnology (95 pp.) with satisfactory detail. Geographic meteorology (71 pp.) is safely intrusted to Hann of Vienna. Among the many important memoirs referred to, we may mention Supan's, on the distribution of annual variations of temperature; those by Teisserence de Bort and Wild, on the relation between isobars and thermic isabnormals; Spindler's paper on the strength and inclination of the wind in storms; and several others on meteorological cycles. Concerning the latter, Hann says, in effect, that the hope that such cycles might afford a foundation for long-range prognostics has proved delusive, and the problem is at present of purely scientific, not practical, interest. Whipple's inquiry into the periodicity of rainfall is quoted as proving the absence of any short cycles of between five and thirteen years' duration, so that it can be definitely said that predictions of wet or dry years on the basis of previous observations are quite worthless. So, also, Hoffmeyer's study of the North Atlantic tempests serves to show the inaccuracy, to say the least, of the *New-York herald's* cable-warnings to western Europe. Forty-four pages are devoted to questions of regional climate.

Dr. Zöppritz of Königsberg is allowed forty-two pages for the progress of terrestrial physics (*geophysik*). In commenting on Professor George Darwin's work on the effect of the tides upon the moon's distance, and on Mr. Ball's entertaining lecture, 'A glimpse through the corridors of time,' on the same subject, the reviewer accepts Professor Newberry's conclusion that the moon must have already attained its actual distance from us when our oldest Cambrian and Silurian strata were deposited. This seems an unnecessary adherence to doctrines of uniformity: for, in the spread of our paleozoic strata, there is evidence of much stronger submarine transportation than we now find; and even in Jurassic times there is a surprising area of cross-bedded sandstones in the region of the Colorado plateau. We agree more fully with the author, in his opinion that Mr. O. Fisher has, in his 'Physics of the earth's crust,' rather overvalued the strength of his conclusions, and again in objecting to the theory of the permanence of continents. Under glaciers, the discussion by Forel, of their periodic variations in Switzerland as dependent on preceding and not contemporaneous climatic irregularities, is regarded as of especial importance. Forel was preceded in this idea by Güssfeldt.[1]

Geodesy and cartography are also discussed; and a list is given of geographic societies, which now number seventy-nine, and of geographic journals, which have recently increased rapidly to the number of one hundred and nineteen. Among the societies, the Royal geographical society of London leads the list

[1] Ueber die eisverhältnisse der hochgebirge. Verh. ges. erdk. Berlin, vi., 1879, 86.

with a membership of 3,373, and an income of about nine thousand pounds sterling.

There remain still two chapters to which we hope later to call attention in special notices, — one by Egli of Zurich on the present condition of geographic onomatology, or the study of names; the other, by the editor, on the development of the study and method of teaching of geography, a matter discussed with much seriousness in Germany, though receiving small attention here.

In concluding the present notice, it may be said, that while the *Geographisches jahrbuch*, like other works of its class, by no means serves the purpose of final reference, it is of the greatest value as an aid in all geographic studies; and the special feature of arrangement according to place makes it a most valuable supplement to other bibliographic works in which the classification is according to subjects.

MASCART'S ELECTRICITY AND MAGNETISM.

Leçons sur l'électricité et le magnétisme. Par E. MASCART et J. JOUBERT. vol. i. Paris, 1882. 8°.
A treatise on electricity and magnetism. By the same; translated by E. ATKINSON. vol. i. London, *De la Rue*, 1883. 662 pp. 8°.

ONE feels, in reading Maxwell's treatise on electricity and magnetism, that the author had a grip upon the subject which has only been approximately attained by other writers. Although the style is obscure, and the arrangement often merits the word 'atrocious,' — for equations are taken for granted which are afterwards proved, and other equations are referred to in general without particular specification; so that the student who comes to the book with mediocre preparation, and is determined to master it, cannot fail to have a feeling allied to bitterness with the author who has led him over such a corduroy road to a promised land, — nevertheless, the grip is there, and one always feels it; and each paragraph is full of suggestion.

The treatise of Mascart and Joubert is Maxwell's treatise very much simplified. It has the Gallic flow, but it has not the Scottish grip. It is Cummings's admirable little elementary treatise on electricity, treated by the calculus, and amplified with some of the harder portions of Maxwell. It has the appearance of a collection of excellent professorial notes on Maxwell's book.

The volume now printed contains the mechanical theory of electricity; and a second volume on the phenomena and electrical apparatus is promised. The portion on thermo-electricity is more extended than the chapter on the same subject in Maxwell's treatise; although, curiously enough, Tait's ingenious method of measuring thermo-electric relations is not given. Much space is devoted to the propagation of what are termed, for convenience, 'electrical waves;' and the action of the telephone is theoretically considered. In the treatment of electro-dynamics the principle of symmetry is often employed in a clear manner. It is noticeable throughout the work that the authors are patriotic, and the special investigations of Frenchmen are often alluded to. We miss, however, full notices of contemporaneous investigations by Germans and by Americans. Perhaps these will appear in the following volume. The chapters on magnetism are very suggestive, and in them the various theories are presented in a clear manner. Thomson's papers on magnetism are given at considerable length, mainly as they are contained in his 'Papers on electro-statics and electro-magnetism.' The view that diamagnetism is merely the difference between the magnetic character of the medium in which the small diamagnetic substance is suspended, and the magnetic character of the substance itself, is popularized by presenting the analogy between this phenomenon of magnetism and the action of bodies floating in fluids of different specific gravities. This hypothesis makes the ether of space a magnetic medium, with a greater coefficient of magnetization than that of any known diamagnetic substance. The analytic processes of the authors are, in general, simple. Laplace's and Legendre's coefficients are used only in a limited way in the subject of magnetism. Perhaps this may be regarded as an advantage in the treatment. What is needed at present is an extended treatise on the application of spherical harmonics to practical problems in electricity and magnetism, and to problems of attracting forces in general, in order to show the availability of this method of analysis.

The authors treat the subject of electro-magnetic induction in a clear way. The retarding effect of induction on the swing of a galvanometer needle is clearly set forth, and the work of electrical motors receives some attention. More will probably be given in the next volume. Hall's phenomenon is treated in a far-off manner. The authors state that "Hall's phenomenon would seem to be in contradiction with the opinion generally adopted, that in electro-magnetic phenomena the action

is exerted on the *supports* of the currents, and not on the currents themselves. But, however we may explain the experiment, it follows that a magnetic field in the stationary state develops an electromotive force which tends to move electricity in the direction of the electro-magnetic action; that is, to the left of an observer placed in the current, and who is looking in the direction of the magnetic force." Perhaps one cannot do more than make the above statement in the present state of our knowledge; but the fact that the phenomenon in question is different in different metals shows the influence of the *supports*. In general, we like the arrangements of the topics treated better than that of Maxwell; and we hope that this book marks the revival of a period of graceful and lucid treatises on mathematical physics which we have a right to expect from Frenchmen.

The English translation of this work by Dr. Atkinson is well executed, and is revised by the authors, who have added certain portions to it which are not contained in the French treatise. We have noticed here and there faults in punctuation which add to the difficulty of comprehending certain relations.

LARISON'S TENTING-SCHOOL.

The tenting-school: a description of the tours taken and the field-work done by the class in geography, in the Academy of science and art at Ringos, N.J., during the year 1882. By C. W. LARISON, M.D., principal of the academy, etc. Ringos, N.J., *Larison*, 1883. 292 p. 12°.

THIS is an amazingly queer little book, — so full, indeed, of oddities, that one is at a loss where to begin an account of them. In the first place, the author is evidently one of our orthoepomaniacs. Nearly all the vowels, and many of the consonants, are decorated with diacritical points. The result is, that the pages have a singularly bristling and formidable aspect. But we advise the reader to discipline his eye to this painful amelioration of the written speech, for a reward awaits him. Behind this printed '*chevaux-de-frise*' there is a lot of things worth reading. The first effort of the author is to tell just how he managed for the conveyance and camping of a party of students, boys and girls. Every little detail for the construction and equipment of a wagon and camp for eighteen persons is carefully set forth. The most trifling articles are figured in rude woodcuts. All this, though in its way useful, would be tedious but for the *naïve* though often cumbrous language in which it is given, and the strangely complicated ways of meeting simple needs. When, for instance, he comes to the making of the camp-fire, which the untutored campaigner accomplishes as best he may, our author tells his very ingenious way. The plan is so altogether good, that we give it in full, unhappily omitting the diacritical accents, which are beyond the resources of an ordinary press.

"To kindle fire, we use a kind of strong iron cup, fastened to an iron handle about three feet long. This cup is very wide at the top and will hold about a quart. In this cup, we place a handful or more of resin, a gill or more of kerosene, and about a tablespoonful of a mixture, consisting of one part of ether and four parts of alcohol. At first thought, this may seem to be a very incompatible mixture; but, of its practical value, we have much evidence. To start a fire in wet wood, during a rainy day, under ordinary circumstances, is not easy; but with the arrangement, and the fuel above named, it is readily effected.

"To ignite resin, in the open air, with an ordinary match, is almost impossible. To ignite kerosene in the open air with a match, is not easy; and to fire alcohol in an open pan, with a match, is not done at every trial. Each of these substances require (*sic*) to be heated up to a certain point, — the kindling point, before they will ignite. To raise the temperature of either of these to the kindling point, requires more heat than is developed by the burning of a match; but, ether is so volatile, that when poured out, its vapor instantly rises. This vapor fires at so low a temperature, that when a burning match is brought in contact with it, it ignites with explosive violence, and continues to burn with vigor until consumed. While burning, the heat generated, evaporates the alcohol, raises the temperature of the alcoholic vapor to the burning point, and ignites it. By the burning of the alcohol, the kerosene vapor is raised to the kindling point, and is ignited. The burning of the kerosene soon develops heat enough to liquify (*sic*) the resin, evaporates it and ignites it. At this juncture, a part of the kerosene and resin begins to be converted into a gas that makes a hotter blaze than that made by burning either kerosene or resin alone; besides, attending this fire is much less smoke than is made by the burning of resin alone.

"The cup of burning kerosene and resin, when placed under a heap of wood that is not too wet, soon raises the fuel to the kindling point, ignites it and gives to the fire such impetuosity that it makes water boil quickly, and butter to fry and sputter furiously.

"With the cup alone, charged as above directed, I have boiled a two gallon tea kettle of water in eight minutes. But, this could not have been done in a windy day.

"It would be criminal to make the above statement, respecting the iron cup and the fuel to be used with it, without informing the tiro that it is very dangerous. Should any one attempt to use it, he cannot be too careful. The act of touching it off with a match, unless circumspectly done, may prove very disastrous. The results of using this mixture without sufficient circumspection we have seen. Suffice it to say, they were terrible."

Unhappily, our author does not give a picture showing the effects of these occasional catastrophes on the camp of innocents; but

at least he might have told us how to apply the circumspection.

Like many another victualler of youth, he has very dark views about the hungry camper, or, as he sadly calls him, the 'stomach-man.' He thus exhorts him by picturing the perfect primal man: —

"In reference to this subject, this fact should be kept in view. The type man, the formative man, was symmetrical. Neither his intellectual, nor his sensual, faculties predominated. Temperate in all things, he appreciated and enjoyed the beautiful, the euphonic, the fragrant, the relishful and the eupathic. He suffered, — but to him his task was not onerous; he enjoyed, — but his fruition did not engender ecstasy. Virtuous, — he met what was before him with fortitude. Brave, — he triumphed in every struggle for right. From birth till death, all was satisfactory, all was enjoyable."

The most of the book is filled with accounts of short excursions in New Jersey. They are commonplace enough in their matter, and are only interesting from the indescribably queer tone that pervades them. There are many singular criticisms on the manners and customs of the folk at the summer resorts on the Jersey coast: they are vulgar enough, but the pervading queerness of the text makes them interesting.

This essentially worthless little book meets a growing interest in the free life that the camp alone can give the summerer. Our country with its abundant wildernesses, with the tolerance of its country folk for what would in other lands be called trespasses, lends itself to this charming method of travel. It is much to be desired that some master of the fine art of decent living in rough conditions should give us a manual for the guidance of beginners in its mysteries.

ETHNOLOGICAL PSYCHOLOGY.

Zur naturwissenschaftlichen behandlungsweise der psychologie durch und für die völkerkunde. Von A. BASTIAN. Berlin, 1883. 234 p. 8°.

THE idea pervading all of the more recent publications of Adolf Bastian is to establish a science of psychology of nations upon the data of modern ethnography. The all-pervading influence of nature forms and shapes peoples, nationalities, and their customs and habits; and therefore ethnology must become a natural science, — the physical science of the mind as manifested in the development of each nation in particular, and all the nations taken as a whole. The withdrawing of ethnology from metaphysical influences, under which it has labored since it was made a scientific study, is possible only when a sufficiently large material has been collected among the nations of the globe and the records of history to establish on it incontrovertibly general principles, which will be found to rest on natural science, and not on philosophic speculation. Some parts of the vast field of ethnology are still obscure as to their real significance, because the material to judge from is too scattering and scanty. Bastian's most recent work contains a series of seven articles, mainly on Polynesian subjects, which uphold and illustrate his ideas concerning ethnology, as stated above, with a full array of the most erudite comparisons. The author's extensive travels have furnished him with a stock of ethnographic facts which none has equalled in our century, and which he readily compares on almost every page with notices derived from the classic writers. Concerning the progress traceable on the social development of man, the writer shows, that, considered as an individual, the single man is of very small account in the primitive horde. The first stage is the tribe, based on consanguinity with exogamic marriage. This stage passes into that of *civitas*, or citizenship, whenever the country becomes agricultural. Social connection is no longer determined by family ties, but by the extent of the district, country, or commonwealth to which the individual belongs. When tribal organization becomes loose, then blood-revenge, and similar primeval customs, also disappear. The concise style of Bastian is not always what we should desire: at times it becomes rambling, a heavy phraseology obscures its lucidity, and the pressure of thoughts cannot find words enough to give vent to their rapid flow. Such defects as these are more prejudicial to the literary success of Bastian's numerous publications than the typographic errors which the proof-reader has allowed to disfigure their texts, especially the classic quotations.

STOKES'S SCIENTIFIC PAPERS.

Mathematical and physical papers. By GEORGE GABRIEL STOKES, M. A., D. C. L., L L. D., F. R. S., professor of mathematics in the University of Cambridge. Reprinted from the original journals and transactions, with additional notes by the author. Vol. ii. Cambridge, *University press*, 1883. 366 p. 8°.

VOL. i. (328 pages) appeared in 1880, and contains the papers, arranged in chronological order, which were published by the author between April, 1842, and December, 1847. The earliest date in vol. ii. is March, 1848, and

the latest, March, 1850. Vol. iii. is stated by the publishers to be in press.

Of the papers reprinted in these first two volumes, only two of the more important are of a purely mathematical character, and these treat of the properties and methods of computation of infinite periodic series such as arise in many physical problems, which series were first systematically employed and explained by Fourier in 1822. Fourier's treatise [1] is to-day the best introduction to a knowledge of this kind of analysis, besides being one of the most brilliant expositions, in any branch of science, in existence. With the exception of a single paper of 42 pages, upon a differential equation relating to the breaking of railway bridges under loads moving at high speeds, the remaining papers all come under the head of fluid motion in one way or another, and include extensive discussions of the fundamental dynamical equations of motion of perfect fluids, of viscous fluids, and of elastic solids. These discussions treat, among other subjects, the theory of oscillatory waves, the equilibrium of the earth in a fluid state, the variation of the force of gravity on its surface, and the undulatory theory of light.

The work of Professor Stokes in hydrodynamics is of special importance in correcting and rediscussing the results obtained by Lagrange and Poisson, and in paving the way for the more modern developments of Helmholtz and Thomson in vortex motion, and of Maxwell in electricity and magnetism.

[1] Analytical theory of heat. By JOSEPH FOURIER. Translated, with notes, by Alexander Freeman. Cambridge, 1878.

But the papers of Stokes which are probably of most interest to the mathematical physicist of to-day are those upon the undulatory theory of light, in which he has added essentially to our knowledge of the constitution of the luminiferous ether by showing how the phenomena of aberration may remain unaffected by the fixity or motion of the ether, as also by his investigation of the theory of diffraction, by which he has sought to decide whether the vibratory motion of a plane polarized ray lies in the plane of polarization or at right angles to it.

By these investigations, and by others, among which may be noticed that of the colored rings of Newton, he has explained difficulties in Fresnel's undulatory theory, and essentially improved it.

The treatise of Verdet,[1] which is the most complete and important exposition of the undulatory theory yet written, gives a complete bibliography of this subject, extending to many hundred titles, from which the reader can correctly estimate the labors of Professor Stokes in this field.

The lifelong labors of Professor Stokes have given an immense impulse to mathematico-physical research in England; and the republication of these papers by the syndics of the Cambridge university press is a graceful and well-deserved tribute to the Nestor of the greatest mathematical school in the world.

[1] Leçons d'optique physique par E. Verdet. Paris, tome. i., 1869; tome ii., 1872. The following translation and revision to date is in process of publication: Vorlesungen über die wellentheorie des lichtes, von E. Verdet. Herausg. von Dr. Karl Exner, Braunschweig. Bd. i. 1881.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Geologic work in the South Atlantic district.— Owing to the as yet incomplete state of the topographic work in the southern Appalachians, the systematic geologic survey of that section has not yet been commenced. However, several geologic reconnaissances have been made, and considerable collections of paleontologic material have been sent into the main office of the survey. During the season of 1883 Prof. H. R. Geiger examined the geologic structure of a considerable portion of Virginia and West Virginia. During the latter part of July he was in the eastern part of Virginia, but in August transferred his field of work to Greenbrier county, W. Va., where he studied the formations that are exposed between the Greenbrier River and the Lewis Tunnel, just east of Alleghany station, W. Va. A collection of Devonian fossils was made. In September his work was carried into Alleghany county, Va., where a careful examination was made of the rocks so well shown there. The thickness, dip, etc., of the beds were obtained, and an excellent series of typical specimens secured. In October the field was extended northward to Rockingham county, but bad weather impeded the operations. Through November a special study was made of the foldings in the limestones that lie between the Blue Ridge and North Mountain, and a careful comparative examination made of the limestones of Rockingham and Rockbridge counties, Va.

Professor Ira Sayles was assigned to the northeastern part of Tennessee, and adjacent portions of Virginia and Kentucky. The early part of July was spent by him in the examination of the caves near

Clinch River in Virginia. He next examined the coal-beds on Big Yellow Creek in Bell county, Ky., and the Dyestone iron-ore beds a few miles farther down Poor valley. The following month the work on Clinch River was continued in Hancock county, Tenn., especially with the object of ascertaining and more accurately defining the extent and direction of the faulting so well displayed in that section. The upper coal-measures were also examined, and a running field-chart of the county made. In the latter part of the month, Professor Sayles discovered some very interesting cave-deposits in a quarry in Hawkins county, Tenn. The formations of this county were carefully studied during September and October, and large collections of fossils obtained. The latter part of October found Professor Sayles at Knoxville, in accordance with his orders, to examine the vicinity of Knoxville and Centreville for Potsdam fossils to supplement Mr. Walcott's paleontologic work. He was engaged in this region through November and December.

Topographic work in eastern Tennessee. — With a view to facilitate future geologic work, the division for the topographic survey of the southern Appalachian region was organized upon a considerably enlarged scale for the season of 1883. As already noted in *Science*, five topographic and two triangulation parties were put in this field.

Topographic party No. 3, in charge of Mr. Frank M. Pearson, was assigned to the valley of East Tennessee. The territory covered by his party includes about five thousand square miles, lying between parallels 36° and 36° 35′, and between meridians 82° 15′ and 84° 30′. This area is the northern half of the valley of East Tennessee; extending from the summit of the Cumberland Mountains and Cumberland plateau, on the north and west, to the summit of the Smoky Mountains, or state line between North Carolina and Tennessee, on the south and east. The topographical character of this region is such that the methods of work employed in the west had to be somewhat modified. It was necessary to carry on a considerable part of the work by means of compass meander-lines; and the rapidity of this class of work, and of the triangulation, was seriously interfered with on account of the dense timber which prevails everywhere, and by the atmospheric conditions, which are rarely favorable for clear views of any great extent. The prominent topographical features are peculiar. Almost the entire main valley is occupied by parallel ridges, that have their origin in south-western Virginia, and run in a south-westerly direction through Tennessee, and into Alabama and Georgia. In this, of course, the drainage system is simple, the larger streams, with few exceptions, being confined by the ridges which enclose their head waters.

The Bays Mountain, consisting of a great number of these parallel ridges, or mountains, as they are wrongly called, constitutes the divide between the Holston River on the west, and the Nolachucky and French Broad Rivers on the east. In the vicinity of this mountain, and on either side, the drainage is almost entirely underground, the water flowing through and in the limestone strata that underlie this region. This renders the tracing of the streams a difficult matter. The minor drainage collects in numerous sink-holes, which occur on the broad divides from which the streams flow in underground channels, and come to the surface again in unexpected places, and frequently at considerable distance from the point of disappearance. A striking example of this kind of drainage is seen in Mossy Creek, which is also interesting from the luxuriant growth of confervoids and moss with which its bed is covered. This stream rises on the north slope of Bays Mountain, and, after a course of three miles, disappears, and is not seen as a surface-stream for a distance of seven miles, when it re-appears, and flows for three miles to its junction with the Holston River. Five miles from the source of the stream there is a so-called sink-hole, which is six hundred feet in length and of unknown depth. A ninety-foot pole does not touch the bottom. This is really a surface appearance of the stream. A saw-mill was located on the creek a short distance above the first point of disappearance; and the people of the country have frequently noticed that slabs and saw-dust from the mill would rise to the surface in this sink-hole, then disappear, and come to the surface again in Mossy Creek, three miles above its mouth, where it rises for the last time.

Mr. Pearson says that the topographical unity of the ridges and valleys is not recognized by the inhabitants of the country, and hence some confusion has arisen. To the same ridge or valley, often only fifteen or twenty miles in length, as many as five different names are frequently applied; the universal custom being to re-name a ridge or valley whenever it is cut in two or crossed by a stream. This confusion of names also arises partly from the fact that no thorough or connected survey of the region has ever been made, although it is one of the earliest settled portions of the United States.

The natural water-power facilities of the Appalachian region have recently been the subject of much notice, and in this respect the valley of East Tennessee is unexcelled. There are in it many streams of considerable length, affording abundant water-power, that are not indicated on even the best existing maps of the region. Other additions and corrections of considerable importance have been determined by the work of Mr. Pearson.

PUBLIC AND PRIVATE INSTITUTIONS.

Museum of comparative zoölogy.

Arrangement of exhibition-rooms. — The exhibition-rooms are comparatively small, each one devoted to a special subject, but so combined, that, when taken together, they illustrate the animal kingdom as a whole, in its general relations and in its geographical and paleontological range and distribution. They are intended not only to meet the wants of the public at large, and of beginners as well as of more advanced university students, but also to promote research by giving assistance to specialists and original investigators. Meanwhile the work of the mu-

seum proper should be in charge of assistants whose duties are so arranged as to leave a good part of their time free for original research; the museum as a whole forming an important branch of the natural-history department of the university, with which its assistants and professors are intimately connected.

An enumeration of the contents and uses to which the space is devoted will give a better idea of the aims of the museum than a lengthy description.

Exhibition-rooms.

Synoptic room: synopsis of the animal kingdom, living and fossil.

Five systematic rooms for the systematic collections of mammalia, birds, fishes, mollusca, radiates, and protozoa; and their galleries for reptiles, insects, and crustacea.

Seven faunal rooms and galleries: North American, South American, African (including Madagascar), Indian, Australian, Europeo-Siberian,[1] Atlantic,[1] Pacific.[1]

Four rooms for the paleontological collections.

Two rooms for the paleozoic, one for the mesozoic, and one for the tertiary, as follows: Silurian and Devonian,[1] carboniferous and Jura,[1] cretaceous,[1] tertiary.[1]

The work-rooms for the assistants of the museum, and the storage-rooms, which are also intended as work-rooms of their special subjects, are distributed as follows, in addition to a large receiving-room and a general workshop: —

The alcoholic collections stored in the basement occupy four rooms devoted to fishes, two rooms for fishes and reptiles, one room for birds and mammals, one room for mollusca, one room for crustacea, one room for the other invertebrates.

The entomological department is to occupy eventually four gallery-rooms of the first story.

The work rooms and storage-rooms of the fifth story are filled by collections occupying five rooms devoted to birds and mammals, three for skins and eggs and two for skeletons, one for crustacea, one for mollusca, one for fish and reptile skeletons, one for the collection of dry invertebrates (corals, echinoderms, sponges, etc.), two for fossil vertebrates (exclusive of fishes).

[1] Not yet open to the public.

The remaining paleontological collections are crowded into four work and storage rooms. There are two work-rooms for the geological and lithological department. Four rooms are devoted to the library of the museum, and one room for the office of the curator. There are also a large general lecture-room, three laboratories for students in biology, three laboratories for students in geology and paleontology, with two smaller private rooms for the instructors. With the biological laboratories will be connected also a large room for an aquarium for both fresh-water and marine animals, and another room for a vivarium, both of which are in the basement of the building.

This will give, in all, seventeen rooms devoted to the exhibition of collections for the public; ten work and storage rooms in the basement, for the alcoholic collections; thirteen work and storage rooms for the dry zoölogical collections; eight similar rooms for the paleontological and geological collections; and thirteen rooms devoted to the laboratories, lecture-rooms, and library connected with the instruction given at the museum; the arrangement being such, that, whenever any departments (as, for instance, the geological and geographical, or the anatomical, or any other) outgrow their present quarters, room can be made for them by extensions of the building, for a long time to come, without interfering with the plans which have been carried out thus far.

In adopting a small unit for the size of the rooms (30×40 feet), all attempts at exhibition-rooms, imposing from their size, were deliberately abandoned. It is aimed only to place before the public such portions of the collections as shall become instructive; and in the storage and work rooms the appliances for storage aim at economy of space, and are intended, while they do not neglect the careful preservation of the collections, to give to the assistants and students the freest and quickest possible access to them.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Cambridge entomological club.

Feb. 8. — Mr. G. Dimmock called attention to some curious habits of the common European earwig, Forficula auricularia, a specimen of which he had kept in confinement several months. These insects are omnivorous, but apparently prefer insects as food, eating their own species greedily. Although to all appearances blind, except to the presence or absence of light, the specimen above mentioned captured fleas (Pulex irritans) with ease in an enclosure about five centimetres in diameter. No notice was taken of a flea put in the enclosure until the flea actually touched the earwig, when the latter would rush after the flea, palpitating with the antennae rapidly, and thus keeping on his track. If the flea escaped from beneath the antennae of the earwig, the latter would find him again in a moment, and the amusing chase would be renewed, to end in the sure seizure of the flea in the mouth-parts of the earwig. The earwig was a glutton, and would often eat a large number of fleas or other insects in succession, at the end of his repast his abdomen being much distended. —— Mr. S. H. Scudder exhibited a specimen and drawings of an arachnid from the coal-measures of Arkansas. Two years ago Karsch figured a similar form from the coal of Prussian Silesia, under the generic name Anthracomartus, and Kušta has just described another from carbo-

niferous beds in Bohemia. This adds another to the many instances in which a new generic type of carboniferous arthropods had no sooner been announced as found on one continent than it was discovered on the other. The Arkansas species was obtained by Prof. F. S. Harvey of Fayetteville, and had not been in Mr. Scudder's hands a month before a second American species was found by Mr. R. D. Lacoe in the well-known beds of Mazon Creek, Ill.

Biological society of Washington.

Feb. 8. — Mr. W. T. Hornaday read a paper on the guacharo bird of Trinidad, describing the habits of the Steatomis caripensis as observed by him in one of the caves where it breeds. —— Mr. G. Brown Goode read a paper on the aims and limitations of modern fish-culture. Modern fish-culture he defined to be fish-culture carried on upon an immense scale, under the direction of men trained to scientific research, as distinguished from the old and insignificant method of fish-culture carried on by private enterprise. Its aims were shown to be, 1, to arrive at a complete understanding of the life-histories of useful aquatic animals, and the conditions under which they live; and, 2, to apply this knowledge so thoroughly that all fishes shall be brought as completely under control as are now the shad, the salmon, the carp, and the whitefish. The limitations of fish-culture were shown to be the same as those of scientific stock-rearing or agriculture. —— Dr. T. H. Bean made a communication upon an augmented development in the fins of a species of Siphostoma, exhibiting a specimen with a supernumerary anal fin. In the discussion of this paper, Mr. John A. Ryder remarked that this deformity was an attempt toward reversion to the condition of some remote ancestral type in which there was a continuous fin around the posterior portion of the body. —— Mr. C. D. Walcott exhibited a specimen of trilobite, Asaphus sp., in which twenty-six pairs of legs, and the mouth-parts also, were plainly to be seen; also a specimen of Maine granite containing fossil corals, probably of the Devonian age.

Philosophical society of Washington.

Jan. 19. — Mr. Israel C. Russell made a communication on the existing glaciers of the high Sierra in California. After showing the extent of the ancient glaciers of the region, and their relation to the topography, he described in detail the phenomena of the Mount Dana, Mount Lyell, and Parker Creek glaciers, closing his remarks with a reference to the literature of the subject. The Mount Dana glacier lies at the foot of a cliff on the north face of that peak, with an elevation of 11,500 feet above the sea. It is at the head of a deep cañon draining into Lee-Vining Creek, one of the tributaries of Mono Lake. It is approximately 2,500 feet long, and of somewhat greater breadth. Notwithstanding its small size, the distinction between the snow-ice of the *névé* and the solid greenish-blue ice of the glacier proper is clearly marked. Its planes of growth are indicated by a banded structure, — compact ice alternating with thin sheets of porous white ice and with dirt-bands. It is abundantly provided with crevasses, and has a terminal moraine visibly growing. The stones of the moraine show marks of attrition, and the lakelet fed by the outflowing stream is milky from suspended detritus. The Mount Lyell glacier is somewhat larger, and exhibits substantially the same characters. A portion of its surface is characterized by 'ice-pyramids.' These occur only near the foot of the glacier, where the surface is rapidly melting, and depend upon the power of superficial pebbles to rescue the ice immediately beneath them from the porosity elsewhere produced by insolation. The Parker Creek glacier, likewise at the head of a tributary of Mono Lake, resembles the others in its general features, and displays in addition a considerable number of 'glacier-tables,' — blocks of rock perched on standards of ice. A number of other glaciers were seen at a distance of a few miles, but were not visited. The various phenomena were illustrated by photographs.

Mr. Gilbert Thompson described certain glaciers on Mount Shasta believed to be new to science. Their discovery increases the number of known glaciers on the flanks of Shasta to seven. Mr. W. H. Holmes described the glaciers of the Wind River Mountains, and the glaciers of Mount Moran in the Teton Range. The former are from one-fourth of a mile to one mile in length. The latter are three in number, and lie at an altitude of 12,000 feet. Mr. Mark Kerr mentioned the occurrence of a glacier in the Salmon Mountains, a division of the Coast Range.

Prof. W. C. Kerr described the mica-mines of North Carolina, explaining their geological relations, and setting forth the economic and mineralogic results of their exploitation. He described more particularly a series of prehistoric excavations, which are large and numerous, and were evidently made for the purpose of obtaining the same mineral. One of these measures 150 by 75 feet, and, despite a partial filling with *débris*, retains a depth of 35 feet. The ancient work was performed with blunt-pointed tools, doubtless of stone; and facts connected with the arboreal vegetation show that it had been discontinued as much as five hundred years ago.

Scientific club, Manhattan, Kan.

Jan. 18. — Mr. Shartel presented some notes regarding the Suez and Panama canals and the Augsburg tunnel. Mr. Marlatt described a worm which he observed last year. Professor Kellerman made some interesting remarks respecting the occurrence of chlorophyll in animals. Superintendent Graham gave a description of some carvings on a rock in a cave in Greenwood county. These carvings were observed by Mr. Mason, and drawings which he made of them were exhibited. Mrs. Kellerman gave an interesting description of the Termites, or 'white ants.' She described their manners and customs, grades of society, architecture, political economy, and many other points. Mr. Lund read a paper on the undulations of the earth's surface. He cited numerous instances of elevations and depressions that are

taking place at the present time, as well as some of the more remarkable ones of past ages.

Cuvier club, Cincinnati.

Jan. 5. — In their annual report, the trustees stated that the club expended during the year $238.60 in the prosecution of the game-laws. The extension of the open season for quail through November was suggested as not likely to do injury; and attention was called to the continued pollution of waters, and the consequent destruction of fish. The necessity was urged of protecting the National park from the speculator, and such tracts as the Adirondacks from the wood-chopper.

Academy of natural sciences of Philadelphia.

Dec. 11, 1883. — In an account of the formicaries of the carpenter ant, the Rev. H. C. McCook related observations proving that the females of Camponotus pennsylvanicus, when fertilized, go solitary, and, after dispossessing themselves of their wings, begin the work of founding a new family. This work they carry on until enough workers are reared to attend to the active duties of the formicary; as, tending and feeding the young, enlarging the domicile, etc. After that, the queens generally limit their duty to the laying of eggs, and are continually guarded and restricted in their movements by a circle of attendant workers, or 'court.' The facts are further illustrated and enlarged by a series of observations made by Mr. Edward Potts, in accordance with the speaker's suggestions and directions. They establish or confirm the following points: 1. The manner of depositing the eggs, which, as well as the larvae, are cared for by the queen until workers are matured; 2. The stages in the development of the egg and larvae are partially noted; 3. The time required for the change from larval to pupal state is about thirty days; 4. About the same period is spent in the pupal state, the entire period of transformation being about sixty days; 5. The work of rearing the first broods begins the latter part of June, or early in July; 6. About twenty-four hours are spent by larvae in spinning the cocoon; 7. The ant-queen probably assists the callow antling to emerge from its case; 8. Not only the larvae, but occasionally the antlings, are fed by the queen; 9. The young workers, shortly after emerging, begin the duty of nurses, caring for the eggs, and tending the larvae.

Jan. 1. — Professor Joseph Leidy exhibited specimens of tin ore from the Black Hills, Dakota. They consisted of a mass of granite containing cassiterite, a fragment of quartz with the same, and a mass of pure cassiterite of about one-pound weight. He had also seen several pounds of large grains obtained from gold-washings. From among these he had picked out several characteristic crystals.

NOTES AND NEWS.

THE death, last Friday, of Professor Arnold Guyot of Princeton, removes one more of those distinguished men of broad scientific culture, who, nurtured in Europe, have given the best fruits of their lives to America. His influence on the young men under his teaching was second only to that of his devoted friend and countryman, Agassiz. We shall speak more at length of his life and characteristics in a future number.

— It will be a source of pleasure to those who are aware of the reliable and conscientious character of Dr. Joseph Leidy's contributions to science, to learn that he has been awarded by the Geological society of London the 'Lyell medal,' with its accompanying purse of twenty-five pounds, in recognition of his important services to paleontology. In a letter received from Warington W. Smith, foreign secretary of the Geological society, dated Jan. 25, Dr. Leidy is advised of the award, and requested to depute some fellow of the society to receive the same at the anniversary meeting to be held on the 15th inst., for transmission to Philadelphia.

— The fourth volume of the census reports has been issued from the press. This is upon the 'agencies of transportation,' and includes the statistics of railroads, steam-navigation, canals, telegraphs, and telephones. Naturally the first of these subjects takes up the bulk of the volume, monopolizing 651 pages out of a total of 869. The statistics and discussion of this subject, as well as of telegraphs and telephones, have been prepared by Mr. A. E. Shuman, whose thorough acquaintance with the subjects, and whose painstaking care, are amply illustrated by the reports in question.

The total railroad mileage in operation on June 1, 1880, is given as 87,781 $\frac{97}{100}$. This was under the management of 631 corporations. The total cost of construction was $4,112,367,176, and of equipment, $418,045,458. The assets of the whole system amounted to $5,536,419,788, and the liabilities, $5,425,722,560. The paid-in capital stock aggregated $2,613,606,264, over 80% of which earned a profit at an average rate of $6\frac{32}{100}$%. The total number of stockholders (estimated, in part) was not far from 300,000, giving an average of $8,700 of stock to each. The aggregate freight mileage was 32,348,846,693, and the passenger mileage, 5,740,112,502. To illustrate the amount of railroad travel, it may be said that this represents an average travel of 114 miles for each man, woman, and child in the country. The above figures, when contrasted with those representing the condition of the railroad interest in this country at the close of 1882, show an immense growth during the two years and a half. At the latter date there were in operation not fewer than 117,717 miles, an increase of 29,835 miles, while the capital had increased in approximately the same proportion. At that date the total railroad mileage of the globe is given (Spofford's Almanac) as 264,826, of which this country owned over 44%. The total of all Europe was less than that of the United States, being but 105,895. The statistical tables of the report upon railroads contain, 1°, a general financial exhibit of the several roads; 2°, a general balance-sheet; 3°, traffic operations; 4°, passenger and freight mileage; and,

5°, equipment and employees. A second portion of the report relates to the physical characteristics of the roads, with statistics regarding the history of construction, grades, curves, roadway, and tracks. This is followed by an analysis of the funded debts of railroad corporations, and by a statement regarding the amount and kind of fuel used. The report concludes with a condensed statement of the agreements existing between different railroad companies, and between these companies on the one hand, and express and sleeping car companies on the other.

The report by Mr. T. C. Purdy, upon steam-navigation, opens with a history of that subject, in which the progress of development of the species, the highest type of which is our ocean-going steamship, is briefly sketched. The tables show the number, tonnage, value, capital invested, service, and traffic of our steam-craft. The report upon canals, by the same author, opens with a history of canal construction in this country. Many persons at the present day will doubtless be surprised to learn the extent to which this class of internal improvements was pushed during the period between 1825 and 1840. The total length of canals constructed in this country was $4,468\frac{6}{10}$ miles, costing $214,041,802. Of this, $1,953\frac{6}{10}$ miles have been abandoned, and a large part of the remainder is not paying expenses. The statistics connected with this report give financial statements, date of construction, dimensions of canals, and the number and dimensions of locks.

The report upon telegraphs opens with a brief discussion of the statistics. The tables contain a general financial exhibit, a statement of volume of business, number of employees, and description of lines. The report upon telephones is of a very similar character. In regard to this, it should be borne in mind that the telephone was in its infancy during the year to which the statistics refer, and that its use has increased enormously during the years which have elapsed since. Following this report is a paper upon the postal-telegraph service in foreign countries, which cannot fail to prove of great interest at this time, when the question of a government telegraph is being actively agitated in this country. This report has been compiled by Mr. Robert B. Lines, mainly from information received from the heads of the departments of postal telegraph of foreign countries through our representatives. It details the history of the postal telegraph in each country where it exists, sketches the methods of business management, and compares the administration by the government with that by private hands, both as to cheapness and efficiency. The following countries support telegraphs which, either wholly or in part, supplant private undertakings: Great Britain, Germany, France, Austro-Hungary, Russia, Switzerland, Belgium, Netherlands, Sweden, Norway, Denmark, Portugal, Roumania, Turkey, Brazil, Japan, Canada, and New Zealand, — in short, nearly every civilized country. In most cases the telegraph has been the property of the state since its introduction, but in a few cases the property has been purchased from private owners. This was the case with Great Britain, who bought out the telegraph companies in 1870. The price paid for the property was based upon the net earnings in the year ending June 30, 1868, by capitalizing that amount at five per cent. The transfer from private to public hands has been found to be advantageous; as not only have the rates been largely reduced, but this department has been more than self-supporting, having earned in twelve years (from 1870 to 1881 inclusive) the sum of £1,996,996. This, however, need not be a matter of surprise; as the uniform rate for twenty words is one shilling (twenty-five cents), and threepence for each additional five words or part of five words. As compared with the rtaes of private corporations in this country, these rates are but little lower for equal distances, while, if we consider the greater density of population and the vastly greater volume of business done in England, it would seem that these rates are relatively quite as high. In most of the continental countries rates are less; and, in all cases where the statistics are given, the expenses of the department have been greater than the receipts.

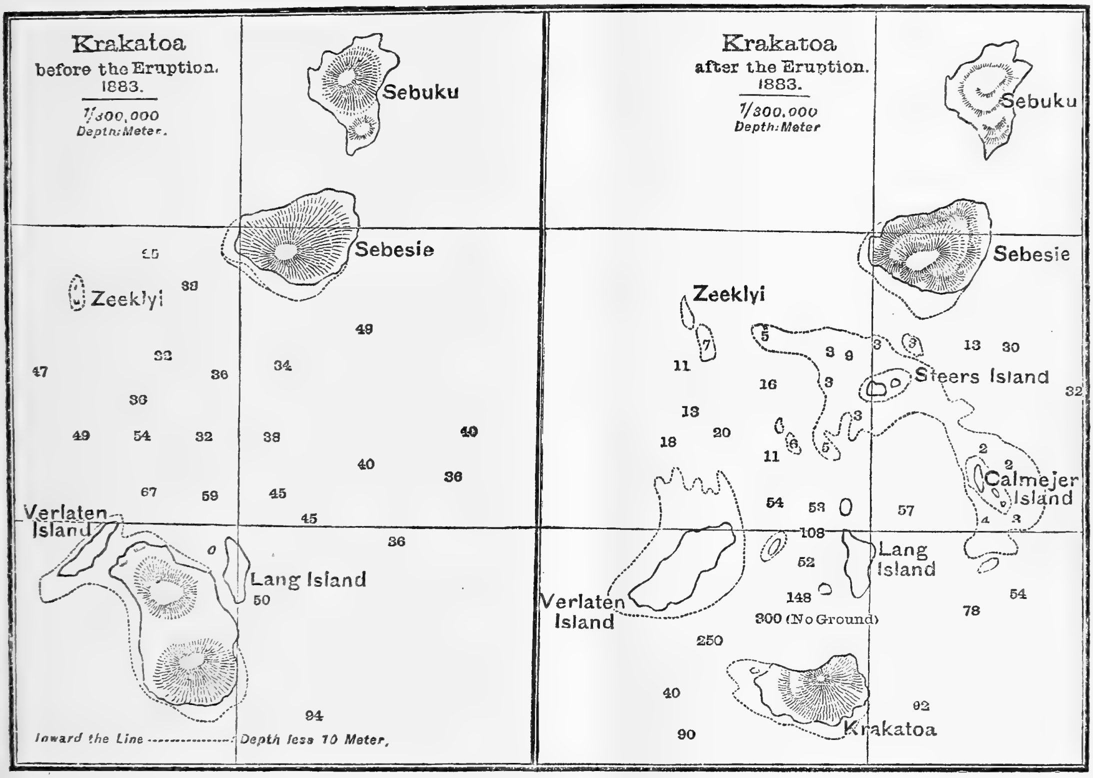
The volume has a very full general index.

— Wedenskii states (*Centralbl. med. wiss.*, 1883, 465) that he has been able to demonstrate the presence of the negative variation of the natural nerve current in a stimulated nerve by means of the telephone in a way similar to that described by Bernstein and Schönlein for the muscle. The quality of the 'nerve-tone' obtained does not differ from that of the telephonic muscle-tone. When, by tying a string around it, the physiological continuity of the nerve was destroyed, the peculiar nerve-tone caused by interruptions of the negative variation current disappeared, while that caused by unipolar action, and of a purely physical origin, could still be heard. The latter tone, however, could be distinguished from the true physiological nerve-tone both by means of its peculiar quality and by the fact that it required a greater strength of stimulus for its production than the former. Chemical and mechanical stimulation were also tried, and in each case a definite noise was heard. When the nerve was stimulated by means of a constant current, a peculiar noise was heard, in accordance with the law of contraction, either at the opening or the closing of the current.

— E. and F. N. Spon announce A pocket-book of electrical tables, for the use of electricians and engineers, by John Munro and A. Jamieson; Absolute electrical and magnetic measurements, reprinted from *Nature*, by A. Gray; Handbook of sanitary information for householders, by Roger S. Tracy.

— The deaths are announced of Mr. Hugh Powell, the first English optician to construct objectives on the water-immersion principle, and one of the founders of the Royal microscopical society, of whom only five now remain; and of the venerable Professor Sven Nilsson of Lund, known for his zoölogical work and his investigations on the prehistoric inhabitants of Scandinavia.

—A correspondent of *Nature*, who has evidently had a good opportunity to study the results of the Krakatoa eruption, and has made soundings in the neighborhood, writes, that instead of the sixteen new volcanoes which were at first reported, and the total destruction of Krakatoa, there is still a considerable portion of the island, and that the greater part of the destruction seems to have come from the wave produced by the eruption and the fall of the masses of material which were thrown from the northern portion of the island. Krakatoa at its northern end now rises in a steep wall eight hundred metres high; and,



where was once land, soundings of three hundred and sixty metres have been made without finding bottom. A large portion of this material appears to have been deposited a few miles to the north, as shown in the map, by the new islands of Steers and Calmejar, and the shoals to the north of Lang Island, which seems to have been about on the line between the upheaval and downfall, and has not been changed materially in size. All the islands are covered with ashes; the destruction of life having been nearly complete, even in Sebuku, the first patches of green showing themselves on the small islands farther north.

—Professor Richard Owen has ceased to be a commoner, having been knighted by the Queen. A banquet was given him by his colleagues on the 21st of January, as a sort of farewell celebration on the event of his resigning the superintendency of the natural-history section of the British museum. Although about eighty years of age, he is still vigorous, and reads papers before the learned societies at nearly every meeting. The establishment of a natural-history museum was long an object for which he toiled. Over twenty years ago he published an address 'on a national museum of natural history,' in which he stated his view relative to the need for, and the proper organization of, such an institution. The new museum is in a large degree the result of his labor.

—The annual course of lectures given under the auspices of the University of Pennsylvania consists this year of The development of the house, by Rev. R. E. Thompson; Why doctors exist, and how they work, by H. C. Wood, M.D.; First aid in emergencies, by J. W. White, M.D.; Order and progress, by Mr. A. S. Bolles; The romance and realities of animal locomotion, by Mr. E. Muybridge; A glance at the lowest forms of life, by J. Leidy, M.D.; Chemistry in the industrial arts, by Mr. S. P. Sadtler; The creation of an empire, or, The life and work of Count Otto von Bismarck, by Mr. E. J. James; Relation of American forests to American prosperity, by J. T. Rothrock, M.D.; How electricity is measured, by G. F. Barker, M.D. The course began Jan. 11; and a lecture will be given every Friday evening till March 21, except on Feb. 22.

— Charles Scribner's Sons announce an important book, by Professor Arnold Guyot, entitled "Creation; or, The biblical cosmogony in the light of modern science."

— The Pilot chart of the North Atlantic Ocean for February shows a smaller number of wrecks than were given on that of last month. The thick scattering of wrecks along our coast from Cape Hatteras to New York, and on the January chart farther north, as compared with those charted on the European coast, attracts immediate attention, but may be due to the more complete information received by the hydrographic office from vessels entering American ports, rather than to greater carelessness or recklessness on the part of American navigators.

— Dr. H. Laspeyres has been appointed professor of mineralogy in the university at Kiel, and Dr. F. Kurtz of Berlin, professor of botany at the university at Cordoba in the Argentine Republic.

— Over a million visitors passed the turnstile of the South Kensington museum during 1883; and since the opening of the museum in June, 1857, the number of visitors is stated to have been 22,675,912.

— The course of 'practical lessons' in anthropology, of the Parker memorial science class, began Jan. 6, and will continue to March 30. Among the subjects of the essays to be discussed we find 'Infant education,' 'Language and its evolution,' 'Heredity,' and 'Allopathy *vs.* homoeopathy.'

— The annual watch-trials undertaken at the Yale college observatory for the encouragement of horology are now in progress, and watches or marine chronometers whose record is to appear in this year's observatory report will be received not later than April 15. The report is published the latter part of June. Full particulars of the conditions of the watch-trials will be furnished upon application to the secretary of the observatory.

— Dr. Benjamin Sharp has been appointed professor of lower invertebrata by the council of the Academy of natural sciences of Philadelphia. Dr. Sharp is a graduate of the University of Pennsylvania, from which he received the degrees of Doctor of medicine and Doctor of philosophy in 1881. He afterwards studied under Leuckart in Leipzig, and under Semper in the University of Wurzburg. He took his degree from the latter after presenting a thesis in German on the anatomy of Ancylus. A translation of this memoir has been published in the proceedings of the academy, and is considered an important addition to our knowledge of the group of animals described. Dr. Sharp was granted the privilege of studying at the Bavarian table in the Zoölogical station at Naples, an honor rarely granted a foreigner. Dr. Sharp proposes delivering lectures, during the coming spring, on the lower forms of life. The course will, in some degree, supply the lack of biological instruction in Philadelphia, which has recently been the subject of public comment.

— Barnum's 'white elephant' arrived at the Zoölogical gardens on Jan. 17, since which time it has attracted much attention. To call the elephant 'white' is certainly to use that term in a very broad sense. The general color of the animal, which is a male about seven feet high, is a light gray, perhaps a shade lighter than is usual. The only parts which approach white are the tips of the ears, the breast, a space in front of and behind the eyes, the middle of the forehead, and a space under the ears. The color in these regions is a sort of dull fleshy tint, although the blotch on the forehead has a brownish tinge. The blotches are very irregularly margined, and plentifully sprinkled with small spots of the normal gray of the body. A much more remarkable feature than these slight irregularities of color is the length of the tail: the tuft at its extremity all but touches the ground. The elephant appears to be in excellent condition, and has fine pointed tusks.

— Upon the resignation of Professor (now Sir) Richard Owen from the superintendency of the British museum, the trustees of that institution have unanimously chosen Professor William H. Flower, LL.D., F.R.S., F.Z.S., etc., to be his successor. In accepting this position, Professor Flower will probably sever his connection with the Museum of the Royal college of surgeons, of which he has been for a number of years the conservator. In the latter position he also succeeded Professor Owen.

The election of Professor Flower to the prominent and responsible post of superintendent must be regarded as a very happy occurrence. His numerous contributions to mammalogy (especially to the knowledge of the cetacea) and to other branches of zoölogy entitle him to the high rank which he holds in England and throughout the scientific world. His administrative ability is amply displayed in the perfection to which he has brought the arrangement of the collections of the Royal college of surgeons.

The keepers of the several departments of the Natural-history museum who are next in rank to the superintendent are as follows: keeper of zoölogy, Dr. Albert Günther; assistant, Arthur G. Butler; keeper of geology, Dr. H. Woodward; assistant, R. Etheridge; keeper of mineralogy, L. Fletcher; keeper of botany, W. Carruthers.

Professor Flower is at present engaged in the preparation of a series of lectures on anthropology, to be delivered in the coming spring; in the publication of a complete catalogue of the collection of the College of surgeons; and of numerous scientific papers of importance, notably, one upon the Delphinidae.

— The sixth fasciculus of Dr. Fisher's *Manuel de conchyliologie* has appeared, carrying the work from Siphonaria, through the opisthobranchs, nucleobranchs, and to the beginning of the prosobranchs, including the Toxoglossa and Rhachiglossa as far as the Volutidae. The character of the work is fully maintained, or, if any thing, becomes more satisfactory as the better-studied groups are taken up. About three-fifths of the work has now appeared.

— *Papilio*, a journal devoted solely to Lepidoptera, and published for three years as the organ of the New-York entomological club, under the superintendence of Mr. Henry Edwards, is to be transferred to Philadelphia, and edited by Eugene M. Aaron.

SCIENCE.

FRIDAY, FEBRUARY 22, 1884.

COMMENT AND CRITICISM.

It was an old theory, taught in text-books of philosophy, that the conclusions of mathematics were absolutely certain, — quite exempt, in fact, from that liability to error which so troubles our conclusions on other subjects. Yet disagreements among mathematicians upon the demonstrable results of their science, even if rare, are not wholly unknown. A remarkable case of this sort is now seen in a discussion which has been going on since last summer in the Royal astronomical society of London. Mr. E. J. Stone, president of the society, and director of the Radcliffe observatory at Oxford, informed the society that he had detected a serious error in the astronomical measurement of time, arising from the substitution of Le Verrier's tables of the sun in the *British nautical almanac* in 1864 in place of the old ones. To this cause, he claimed, were due certain extraordinary errors in the tables of the moon, which had perplexed astronomers for the past ten years. At the same time he communicated to the Royal society an extended memoir, in which he gave several elaborate demonstrations of his views.

These papers no sooner appeared than the new theory became the object of attack on all sides. Such astronomers as Airy, Adams, Cayley, and Christie, in England, as well as their French neighbors, published elaborate refutations, showing that Mr. Stone was wholly mistaken. His carefully prepared memoir was refused admission to the Philosophical transactions. If mere numbers or authority could have settled the question, Mr. Stone would have been crushed; but he has so far maintained his ground against his numerous opponents with a perseverance which we cannot but admire, how little soever we may share his views. After going on for eight months, the discussion seems to be as lively as ever. Its most curious feature is, that the questions involved are purely mathematical. The new tables of the sun make the year shorter than the old ones by about one and a half seconds. Mr. Stone claims that the unit of time is changed by this same amount; that is, that we are using a new measure of time, which is gaining on the old one at the rate of three seconds every two years, so that it has gone ahead thirty seconds since 1864. His opponents claim that this is absurd, since it is not the year, but the day, which is taken as the fundamental unit; and the change in the length of the day is totally inappreciable. As yet, the dispute shows no signs of approaching its end.

It is stated that the outlines of the plan for the Greely relief expedition, approved by the Navy department, are practically as follows: the relief party to go north in two vessels, reaching Upernavik not later than May 15; thence to Littleton Island, endeavoring to open communication with the Eskimos at Cape York. A depot with one year's supplies, coal, clothing, boats, and a steam-launch, should be established at Littleton Island by the first ship, and left in charge of an officer and two men. This vessel would then approach the borders of the pack, and push northward at the first favorable opportunity; the second vessel to cruise about the edge of the ice, and hold herself in readiness to establish another depot on shore in case the first vessel be lost, and the second required to proceed northward in her place. Should Smith Sound be comparatively open, the first vessel will proceed to form secondary depots at or near Washington Irving Island, Cape Collinson, and Carl Ritter Bay; the second, after making a depot at Cape Sabine, to proceed north not farther than Dobbin Bay, unless required by disaster to the first vessel.

In the latter case, before proceeding farther, the second vessel is to land her house, two boats, and a year's supplies for the whole party, in the vicinity of Dobbin Bay. Should both vessels avoid disaster, yet not succeed in communicating with Greely, one is to winter in Franklin Pierce Bay, and the other near Littleton Island. The coast is to be examined on the way north, and cairns enclosing notices of the relief party's plans established at prominent points on both coasts. The naval vessel or tender is to go as far as Littleton Island or Cape Sabine. Whalers and sealers are to be asked to keep watch of the ice-floes for any drifting party. It is also suggested that an advance ship be sent up still earlier, if possible, to relieve the Greely party, if by any chance they should have reached the Danish settlements or the entrance of Smith Sound. It is stated that Commander W. S. Schley, U.S. N., has been selected to take charge of the expedition.

In many respects this plan seems well considered, and, in proper hands, likely to succeed in the desired object. It may be doubted, however, if the projectors fully realize the inadvisability of too great haste in attempting to proceed northward of Littleton Island, or the strong probability that no satisfactory opportunity for northward progress will occur in the natural course of things much before the end of July. Nothing would be easier than to grind up two or twenty of the strongest ships by pushing them into the pack too early. On the other hand, a proper method of early relief preceding the time of navigation — namely, by small coastwise boat and sledge parties combined — does not seem to have received any consideration in the report. Such parties would be much more likely to get early information than any number of vessels entangled in the floes off shore. It is certain, from all previous experience, that the chances are greatly in favor of finding the party on the western shore rather than on the Greenland coast. The probability of their having been able to reach Littleton Island is infinitesimal. We hope, that, in addition to the government expedition, a large reward will at once be offered to any one who may succeed in rescuing the party. This would enable private parties to make their preparations for such an attempt before all the whalers and sealers have left port, would greatly increase the chances of a rescue, and would put all parties on their mettle. To neglect this precaution would be almost criminal.

The destruction of the forests is frequently assigned as an efficient cause of freshets. But all the primeval forests which covered the head waters of the Ohio did not prevent freshets, nor could they under certain combinations of circumstances. A wide-spread storm, with heavy rain on frozen ground and snow, such as to raise all its tributaries at once, must inevitably cause a flood. The floods of early days were of longer duration than those of to-day, by reason of the forests standing upon the river-bottoms and adjacent banks, which became filled with matted drift-wood, forming a tangled mass which obstructed rapid flow, and through which the water found its way but slowly. The most serious effect of the denudation of the land is the increased erosion to which it is exposed, by which the fertile soil, unprotected by vegetation, is swept by the rains into the rivers, and lost. The magnitude of this loss, and the great erosive effect of water on the clay soil of the west, can only be realized by those who have observed the tawny floods, thick with mud, which flow through the deep and wide valleys which the western rivers have cut in the soft earth.

In bright lands like Australia, where sunshine is sometimes so prevalent as to give rise to complaint, it would seem that the advent of the rain-doctor should cause no alarm. Mr. Russell, the government astronomer of New South Wales, has, however, gone a long way toward discouraging the endeavors of this well-minded individual, notwithstanding his offer to work reasonably, as it will appear to some, with nitroglycerine, with cannon, with elec-

trical machines, with kites, etc. But Mr. Russell predicts his speedy loss of position in the modern social scale, if, having no correct understanding of cause and effect, he pretends to pull down the clouds with a wire, or frighten them with a few crackers. In this habit of belief, apparently so thoroughly ingrained in human nature, that a comparatively slight artificial commotion in the atmosphere is enough either to bring rain out of a clear sky, or to superinduce a calm in violent storms, there is, it must be confessed, something akin to the popular conception of homoeopathy. But in countries other than Australia it may be possible that the necessary condition of unstable equilibrium is more frequently attained, when artificial rain might be a matter of easy production. For Australia, however, there can be little doubt that Mr. Russell is in the right; and when, as he remarks, so many proposals are put forward, some even going so far as to propose that his government should take to cannonading the sky, it is time that some one took the matter up.

THE Philadelphia papers are vigorously discussing Dr. Harrison's plan for a biological institute in that city, and the outlook for it appears favorable. The only exception that has been taken to the plan has been doubt as to the desirability of creating an independent institution, when the work might better be intrusted to the already existing academy or university. This is comparatively unimportant: what is essential is a separate and ample endowment in safe hands. Yet it must be said, that neither of those establishments carries on its work primarily for the training of *investigators*, which is the special aim of the proposed institute; and such an institute Philadelphia absolutely requires, if it would not lose the position it has long held in American science. The academy certainly has neither room nor funds for the purpose; and being at this moment before the public, asking for a large sum of money for building-purposes, only to carry out more fully work in which it has long been engaged, it would be hampered rather than aided by the partial endowment which would probably result for either purpose.

THE legislatures of Virginia and Maryland, stirred by the approaching failure of the oyster-crop, are moving for protection for the beds in apparent good faith. Something will doubtless be done; but the devastation has gone so far, that no immediate improvement can reasonably be expected.

RETURNING to the question of the use of copper as a prophylactic in cholera cases, so much discussed during the recent Egyptian epidemic, Mr. Vulpian presented a note to the French academy, at a recent meeting, written by Mr. Axel Lamm of Stockholm. Mr. Lamm states, that it is a fact that the workers in the copper-mines of Fahlun, in Dalecarlia, did escape during the epidemic of 1834. Judging by this, plaques of copper were tried as a remedy, placed on the stomachs of the patients in the cholera hospitals. The only result was the formation of verdigris if the plaques were not properly cleaned, and consequent ulceration from its caustic action. Fahlun has escaped five or six times, however, when Stockholm has not; and Mr. Axel Lamm suggests the possibility of the great amount of sulphuric-acid gas in the air being the reason, but he has not as yet made any further investigations.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Macrospores in the rocks about Chicago.

SINCE submitting the committee's report on this subject (see p. 237) to the Chicago academy of science, I have continued the investigation of drift material in this vicinity, and from other parts of the northwest. So far as examined, all of the clays on the west shore of Lake Michigan, from Kenosha, Wis., on the north, to the Indiana state line on the south, contain an abundance of the disks, or macrospores, referred to in that paper, both free in the clay and *in situ* in fragments of shale. These clays range from some seventy feet above the level of Lake Michigan to (I am advised) over two hundred feet below its surface.

In the examination of clays from other localities, I get some very unexpected results. In several specimens of 'blue bowlder clay' kindly sent to me by Prof. N. H. Winchell, state geologist of Minnesota, and "taken from fourteen to twenty-one feet below the surface, when digging a well at Litchfield, Meeker

county, Minn.," I find an abundance of macrospores, besides several species of fossil rhizopods, fragments of Diatomaceae, and other organic remains, and several species of well-preserved and characteristic Foraminifera, — among others, Textularia globosa and Rotalia globosa as identified by Professor Joseph Leidy, who advises me that these forms are yet living and common in the Atlantic Ocean. A disk form with crenate margin, much resembling the lorica of an infusorian, is quite abundant, and large quantities of forms and fragments not yet identified. I presume that these fossils are mostly derived from the cretaceous formations, of which the Minnesota clays contain large amounts.

From careful observation and comparison, and the great similarity of much of the contents of the Minnesota clays with what I find associated with the macrospores found here, I am confident that I shall yet find in the Minnesota clays, mingled with the Foraminifera, etc., of the cretaceous formation, the shale and macrospores of the Devonian.

All of the fossils yet identified in the Chicago or Minnesota clays are undoubtedly of marine origin.

B. W. THOMAS.

Chicago, Feb. 11.

Rare Vermont birds.

The work of collecting material for a list of Vermont birds has revealed some notes of particular interest to ornithological students. Quite a number of rare or hitherto unobserved species have been found to be regular summer visitors in certain localities.

The orange-crowned warbler (Helminthophaga celata Say, Bd.), a rare straggler to New England, has been detected breeding in small numbers at Island Lake, Mount Killington, and at Lake Bomoseen in Castleton. In the latter locality, also, the blackpoll warbler (Dendroeca striata Fonst.) is a common summer resident. A specimen of the rare Connecticut warbler (Oporornis agilis Wils., Bd.) was taken at Rutland, April 24, 1879. This is probably the first published record north of Massachusetts. At Burlington I noted several flocks of the Bohemian waxwing (Ampelis garrulus L.), Nov. 25, 1882, and Jan. 21, 1883.

The loggerhead shrike (Lanius Ludovicianus L.) is a regular resident in certain districts in summer. Several nests have been found at Brandon, Rutland, and elsewhere.

White-winged crossbills (Loxia leucoptera Gm.) come frequently in winter, and some are known to breed. The discovery of two nests with young, at Lunenburg, March 22, 1878, by Mr. W. E. Balch, is notable.

The pine linnet or American siskin (Chrysomitris pinus Wils., Bp.) was found nesting at Rutland, May 15, 1879; and Mr. D. C. Worcester discovered two of their nests at Hartland. One was built in a pine in his yard, and commenced in March: the other was in a spruce, and contained young birds by the first week in April.

The black-backed three-toed woodpecker (Picoides arcticus Sw., Gr.), known generally as a casual winter visitor to New England, was found in the capacity of a resident at Lunenburg, where the nests were taken June 1, 1880, and May 29, 1882.

A nest of the American avocet (Recurvirostra americana Gm.) was recorded at Rutland in the spring of 1882; and the Florida gallinule (Gallinula galeata Licht, Bp.), of southern extraction, breeds at Castleton, where several of the birds have been secured. A specimen of the common cormorant (Phalacrocorax carbo L., Leach) was shot on Lake Champlain, and is now in possession of Mr. Jenness Richardson of Rutland, upon whose valuable observations many of these notes are based.

Of the sooty tern (Sterna fuliginosa Gm.), another rare straggler from the south, two specimens have been recently taken in Vermont, — at Rutland and Larrabee's Point, Lake Champlain. Of the still rarer short-tailed tern (Hydrochelidon lariformis L., Coues), Mr. Richardson saw three individuals on Lake Bomoseen, Castleton, one of which he secured.

The sea-dove or dovekie (Alle nigricans Sink), a winter waif from the arctic regions, has been known to occur but once in the state. This was at Sharon, where it was found one morning in the autumn in a gentleman's porch.

Several other birds might be mentioned whose presence here, or in the New-England States, is casual and infrequent. About two hundred species have thus far been noticed within the borders of the state, and it is likely that future observations will largely increase the number.

FRANCIS H. HERRICK.

The red skies in the Pacific.

Only last week I learned from Hon. H. M. Whitney, postmaster-general, that on Sept. 5, Mrs. Whitney and himself distinctly observed the sun's disk, before setting, to be green. His residence is an exception to most of ours in Honolulu, from which trees cut off the view of the horizon. My wife spoke much that night of a strange green cumulus, seen by her ten minutes before calling me to observe the portentous masses of color pouring out all over the sky.

I beg special attention to my remark in the *Hawaiian annual* upon the 'earth's shadow sharply cutting off' the upper rim of the first-glow: —

> "One marvellous effect is often a sudden appearance of thick luminous haze where a minute before all was pellucid, unsullied blue. Meantime the glow especially gathers and deepens above the western horizon along a line of 60 degrees until the whole occident is a uniform sheet of flaming crimson, shading up into lilac and orange. Down upon that creeps the dark earth-shadow, sharply cutting off the edge of the blazing sheet, often serrated with the shadows of remote cumuli. As the shadow descends, the glow deepens, until night has closed down upon it. At once on the darkened sky arises a secondary or 'after'-glow, repeating the same phenomena as the stars come out with almost equal brilliancy of effect. In this after-glow the defined shadow-line is lacking, and the deep fiery red above the horizon bears a singular resemblance to the peculiar reflection on the sky of some immense but remote conflagration. These appearances occur before sunrise with equal brilliancy, but in reversed order."

This effect was very manifest in the strong, heavy glows of September, showing clearly that the first glow reflected the sun's direct rays, while in the after-glow, which had no defined upper rim, but continued much longer, the haze reflects only the light of the first-glow. This bears upon estimates of the height of the haze.

Observers here are well agreed that during November there was a very great abatement of the glows, amounting almost to a cessation, although the whitish corona was always well developed through the day. Early in December the glows were renewed, and for six weeks continued with much uniformity, and quite as brilliant as in October. They are now somewhat abated, although quite uniform nightly. In September and October they were extremely unequal, as well as varying in position of greatest color north or south of west.

The bark C. Southard Hurlburt observed the glow on Sept. 3. She was dismasted in a cyclone, Aug. 18, and came to Honolulu for repairs. On the former

date she was in about latitude 17° north, longitude 125° west. The captain's wife, Mrs. Davis, described the phenomena to me as extremely brilliant.

S. E. BISHOP.

Honolulu, Jan. 30.

The Philadelphia biological institute.

The proposition of Professor Allen of the University of Pennsylvania for the establishment of an institution for the education of both sexes in biological science, is one that he, and many others like minded, have long hoped to see established in Philadelphia. Indeed, it was somewhat expected, when the large building-fund that enabled the Academy of natural sciences to put up its present elegant quarters was asked for, and generously subscribed to principally by the manufacturers of Philadelphia, that something of the kind Professor Allen asks for would be the result. The writer was principal of the school of design for women at the time the successful effort was being made for a new building for the academy; and well does he remember the promises that were then made as temptations to contributors. It may be that 'the representative members of the academy' think that the quite limited extent of the 'educational' plans that they have been pursuing is a fulfilment of the promises then made; and perhaps they are, as they understood it at the time. Yet do I feel quite certain, that if the gentlemen who so generously helped the academy then, and before that time, also were told that the controlling parties of the academy were to refuse to put the building and what there is therein to the use of extended scientific education, it would be to most of them, if not to all, a surprise. I do not mean to say that the academy people have refused to do so; but it looks, from your 'Comment and criticism,' as if something of that kind had been done. My long and intimate experience with 'representative members' of public educational institutions has impressed my mind strongly with the idea that those gentlemen fail to draw distinction enough between themselves and the schools they represent; and, being placed there to manage and direct, they too often seek to carry out *their own ways*, rather than consider broadly the full purpose, scope, and public usefulness, of the institutions under their care, which should ever be rule, amongst evolutionists at least.

The Academy of natural sciences in Philadelphia would be a grand central body, magnificently prepared as a starting-point for biological education; and it would be a pity indeed, if the generous citizens of my old city should be put to the expense of another distinct building, and its professors to the trouble and expense of getting together another collection, perhaps to be placed within a few hundred yards or feet of the present academy. Would it not be more than a mere pity?

T. W. BRAIDWOOD.

Cassiterite from King's Mountain, North Carolina.

Mr. Robert Claywell, a student at the high school at King's Mountain station, on the line between Cleveland and Gaston counties, found in the street of the village a piece of mineral, which he sent me for determination. The mineral turned out to be massive cassiterite, the first found in this state. Ascertaining that there was a considerable amount of it scattered through the surface-soil there, I visited the locality, and instituted some explorations.

My expectations were more than verified when I found pieces of cassiterite from the size of an egg to the finest sand, loose and sticking in quartz, scattered over the surface in a belt beginning about the centre of the village, and extending southward a mile or more. Several shafts were sunk, and trenches dug, which finally exposed a main vein and several smaller veins of quartz and quartzite, bearing the tinstone. The veins are nearly vertical; direction of outcrop, north-east with the rocks of the country. The wall-rock is a mica schist, which is broken down from both sides of the vein at places farther than has been dug. The chief accompanying minerals are tourmaline, titanic iron, mica, and, less abundant, zirkon and rutile. At points the tinstone is disseminated abundantly through the vein-rock: at other points little is found. It is mostly in small grains mingled with the other minerals, tourmaline chiefly. Changes of temperature have broken it out of the surface-rock; and washing the soil yields a black sand, which is composed of the dark-colored minerals mentioned.

The cassiterite is mostly massive or semi-crystallized. I have noticed the forms P, $P\infty$, ∞P, and $\infty P\infty$ in only a few specimens. Hardness, 6.5 to 7; specific gravity, 6.6 to 6.9; color, generally dark brown, but varying from black to almost colorless; composition, mostly an impure cassiterite, with 50 % to 60 % of tin, some specimens running as low as 46 %, others, light-colored ones, as high as 74.4 %. The other ingredients are silica and oxide of iron. So far, I have not detected any sulphur or arsenic.

According to Dr. Emmons, the village of King's Mountain is near the dividing-line between the Laurentian granite and the Huronian slates. To the east of the village the rocks are micaceous and slaty quartzites, talcose slates, and bluish crystalline limestone. A few miles west are the hornblende slates, gneiss, etc.

The only remark on tin which I find in writings on North Carolina mineralogy is the following from Dr. Genth ('Mineralogy of North Carolina'): "No tin ore has been found in North Carolina as yet; traces of this metal have been found in the tungstates of Cabarrus county, *and in a micaceous slate* (Huronian) *in Gaston county*, associated with garnet and columnar topaz" (the Italics and parenthesis are mine). The observation is very interesting in the light of the recent discoveries. Have we not here at King's Mountain, at or near the juncture of these slates and the older gneiss and granite, a concentration of this diffused tin?

CHARLES W. DABNEY, jun.

N.C. experiment-station, Feb 14, 1884.

Behavior of Dolomedes tenebrosus.

Last August I obtained a large female specimen of Dolomedes tenebrosus. It measured over four inches from the tips of the first pair of legs to the fourth pair. It was taken in a swamp, and confined in a tin can, where it remained a day or two before it came into my possession. Upon opening the can, I found it apparently half dead with fright. It had deposited its eggs without attempting to make a cocoon. The appearance of the eggs indicated that it had extruded them prematurely. They were mixed with an abundance of mucilaginous substance, which soon hardened, and held the eggs firmly together and fast to the can. I now put it in a cage, where it soon recovered from its fright. The cage was two by three feet, the top covered with glass, and the bottom uncovered, so that it might have the fresh earth and plants to run among.

I also put the can in the cage; but a colony of small ants (Crematogaster lineolatus) soon found the eggs, and carried them all to their own dominions. It was amusing to see them work and struggle

to separate them from the hardened mucilage. The spider seemed to be looking at the ants, but probably did not comprehend what was going on; for it soon went to work and made a cocoon, which it carried in its mandibles. Several times I tried to take it away, but could not get it without injuring the spider. At last, after it had carried it over three weeks, I saw the cocoon lying on the ground, and supposed it had been abandoned. On pulling it to pieces, I found it composed of a cocoon and chrysalis shell of some moth, together with bits of stick, and parts of the dried flowers of the common everlasting (Gnaphalium polycephalum). While I was examining the cocoon, the spider came back to where it had left the cocoon, and appeared to be looking for it. I now put the fragments (which were partly held together by the web wound around them) near the spider, which immediately seized them with a quick, almost frantic eagerness.

The next morning it had again made quite a respectable-looking cocoon, — an irregular sort of ball, which it persevered in carrying some two months, and I do not know how much longer; as toward the latter part of October it succeeded in making its escape, and carried its precious charge away.

During all this time it took no food. I captured a number of different insects, and put them in the cage, to all of which it paid no attention. Grasshoppers recognized the spider as a foe, and at first seemed paralyzed with fear, but gradually overcame their fright, and became lively in its company.

Mary Treat.

ARNOLD GUYOT.

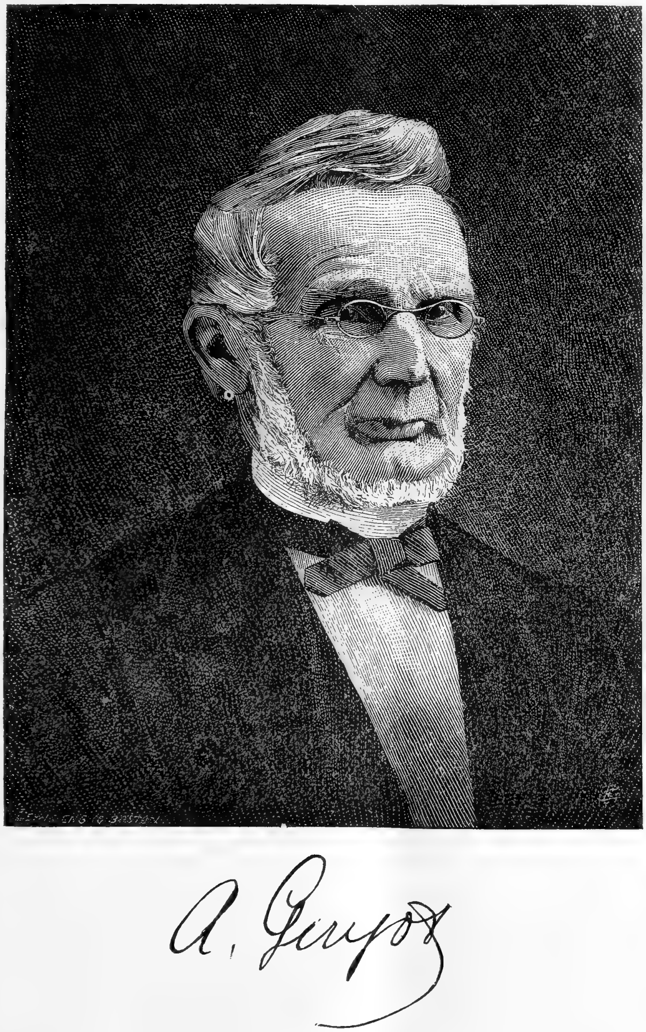
Professor Guyot, whose death occurred at Princeton on the 8th of February, at the age of seventy-seven, is everywhere honored for what he was, as well as for what he did. There is hardly an epithet appropriate to a good scholar, which may not be applied to him, — true, wise, helpful, considerate, devout; accurate, learned, skilful in research, apt to teach, inspiring. His life was devoted to the principle laid down by Smithson for the great institution in Washington, — "the advancement and diffusion of knowledge among men." He was equally ready to engage in a long and tedious investigation, — such as the measurement of a group of mountain peaks, the tracing of lines of bowlders to their sources, the preparation of elaborate tables for the use of meteorologists, and the like, — or to make known in a popular lecture, or before a teachers' institute, or in the conversation of a parlor, or in a series of school-books, the results of his study. He never seemed to be thinking of himself, but always of his subject and his hearers. He cared very little for fame, very much for the study of nature and the education of man.

Like Beck, Follen, Lieber, Agassiz, and several who are still alive, he came to America after his academic training had been completed in foreign schools, and devoted himself to the service of his adopted land with an enthusiasm rarely equalled and never surpassed by the native citizen. He avoided the snare of routine which entraps so many of the college professors of this country; but, by always proposing to himself new lines of inquiry and new subjects of investigation, he kept his mind perpetually fresh, so that, until the infirmities of old age attacked him, he was younger than many of his juniors. He required no 'endowment' in order to lead him to investigation, no instructions, no commission, no salary: all he wanted was freedom. So, when vacation released him from his professor's chair, he took to the field, and, with such comrades as were ready to join him, pursued his geographical researches.

His most original out-of-door work was performed in his own land before he came to this country, where, by a study which lasted for several summers, he succeeded in tracing to their primeval origin some thousands of erratic rocks strewn through the valleys of Switzerland. He thus rendered essential help in elucidating the problem of glacial action which his colleagues, Agassiz and Desor, were engaged in solving. Almost as remarkable was the study which he began, soon after coming to this country, of the great range of Appalachian mountains which borders the Atlantic seaboard, from Maine to Georgia. He determined barometrically the height of the principal summits in the White Mountains, then made a prolonged series of similar measurements in the Black Mountains of the south, then produced a memoir (accompanied by a map) of the entire chain, — a memoir which remains to this day the best existing description. More recently he turned his attention to the Catskills, and revealed the fact, that in this group of mountains, so near to the summer-resorts of wealth and intelligence, the highest peaks were not recorded upon the maps, and inferior peaks were regarded by the scientific visitor and the resident forester alike, as the actual summits. He knew that the problems of nature were always at hand; that careful observation and reflection would reveal some truths of interest and importance, whether the observer were placed in a new country or an old. He was one of those rare men who can ask a hard question, and proceed to answer it.

When he came to this country, in 1849, meteorology was hardly worthy to be called a science. He foresaw what light could be thrown on the law of storms and on the variations of climate by accurate observations extended over vast areas. But he saw, also, the need of good barometrical and thermometrical

instruments, and of accurate tables for the reduction of observations. Under the Smithsonian auspices, he superintended the production of both, applying himself with assiduous labor, for several years, to the preparation and publication of the volume which bears his name, and of which a new edition was in preparation before his final illness. It is easy to see that this work of a pioneer, in a department comparatively new, was of fundamental importance. It helped on the meteorological work which was long superintended by Professor Henry and the Smithsonian observers, and was subsequently developed on a grand scale by the government signal-service.



As we are not endeavoring to review in detail the scientific work of Mr. Guyot, but simply to point out some of the elements of his character, we pass on to his influence as a teacher. For a long while after he came to this country he was a professor without a desk, — a peripatetic teacher, engaged by the Massachusetts board of education to unfold the right principles of geographical instruction. His remarkable insight into the relations of the 'Earth and man' had been developed in the atmosphere of Berlin, when Humboldt, Ritter, and Steffens were in their prime. He learned their methods of thought: he worked out his own. His earliest utterances upon this subject were given at the Lowell institute in 1849, when, with the eloquence of an original thinker, he showed how the earth was fitted to be the dwelling-place of the human race. His task was performed with such profound perception of the truth, and with such suggestive and stimulating reflections, that the unpretentious volume of lectures (notwithstanding the fact that science has revealed so much which was then unknown) remains to this day one of the best introductions to physical geography which the general reader can find in any language. The acquaintance which he formed with American schools and teachers showed him how poor and dry and immethodical were the geographies then in use, how flat and unsuggestive the maps. He endeavored to remedy the evil, and for years was occupied, with skilled co-operators, in the production of a series of wall-maps and text-books, which have since been used in every part of the land. It is not too much to say that they revolutionized the methods of teaching geography. Every series of geographies which has since appeared shows the influence of Guyot.

During a period of nearly thirty years he has been a professor in Princeton college, and his name is cherished by hundreds of loving pupils, who have found in him a friend as well as a teacher; but until a recent period he was easily induced to lecture in other places, and his voice has often been heard in distant cities, expounding his favorite ideas.

The intimacy of Agassiz and Guyot, and the parallel courses of their lives, may be beautifully traced in the memoir of Agassiz which Guyot wrote for the National academy in 1877–78, but did not print until April of last year. It is a biographical gem. The two friends were born in Switzerland, were companions in study, were colleague professors in a post-graduate academy at Neufchâtel, were co-workers in glacial researches, were disturbed by political changes in their native canton, were emigrants to America, were neighbors in Cambridge, were comrades in sensible efforts to make science intelligible to the people, were investigators of American problems. In this memoir of his friend, Guyot has revealed himself by many a characteristic touch. After a fresh perusal of its pages, we are led to wonder how much scientific progress would have been delayed in this country, if it had not been for the inspiring and co-operating influence of these noble immigrants.

Like Faraday, Clerk Maxwell, Agassiz, Joseph Henry, and Benjamin Peirce, Guyot was a man who was devoted to research, who believed in carrying it to the utmost, and yet who was never troubled by the idea of a possible 'conflict' between science and religion. To him nature was a manifestation of God. Natural laws were divine laws. There could be no antagonism between them. On the contrary, he believed that the more we learn of the human soul, of the course of history, and of the structure of the world, the more harmonious will they appear as parts of one great plan. His faith, both in science and in religion, was so strong that his influence kept many clergymen from bigotry, many students from atheism. In him they saw a man to whom the study of science and the worship of God were alike obligatory.

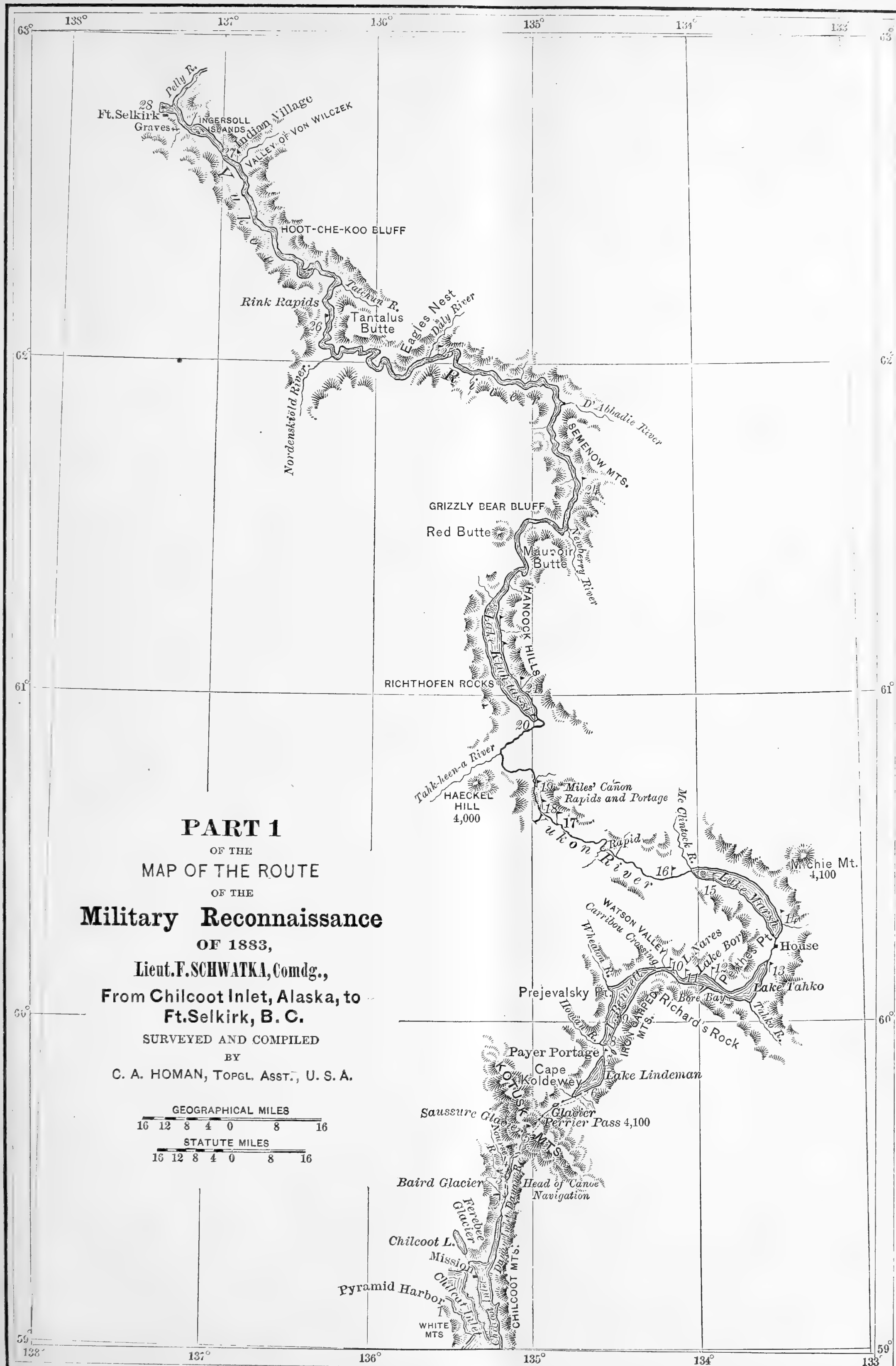
THE ALASKA MILITARY RECONNOISSANCE OF 1883.[1]

THIS expedition arose from a desire of the department commander in the military department in which Alaska territory is situated[2] to gain some military knowledge of the Indian tribes in that district, and especially in those parts recently opened by mining discoveries, fishing industries, and other causes. Besides gaining this information, it has also done something in the interest of science, especially for geography. The part of the route here treated was almost unexplored, excepting the Chilcoot and Dayay inlets, and the portion from the Kotusk Mountains to Lake Lindeman, which had been traversed by the Krause brothers, sent out by the Bremen geographical society. If such an expression may be considered correct, it was really worse than wholly unexplored, in that the maps and books purporting to be authority over this section of the country were erroneous beyond the limits of sensible guessing. The party consisted of seven white persons, — two officers and five others, — and a number of Indians that varied from two to sixty or more.

There are said to be three or four passes through the glacier-clad mountains that separate the salt-water estuaries of the Pacific from the head waters of the Yukon, two of which are known as the Chilcat and Chilcoot trails; and over these two it has been known for about a century that Alaskan Indians of certain tribes had passed, in order to trade with the Indians on the sources of this great stream. The last (the Chilcoot) is the best of all the trails, and was the one undertaken by the party. Why this or the Chilcat route had not been picked out long ago by some explorer, especially those of comparatively recent dates, who could thereby have traversed the entire river in a single summer, instead of combating its swift current from its mouth, seems singular in the light of the above facts, and can only be explained by supposing that those who would place sufficient reliance in Indian reports to put in their maps the gross inaccuracies cited would also be likely to place reliance in the other reports of the same Indians; and these from time immemorial have pronounced this part of the river as unnavigable even for canoes, being filled with rapids, cañons, whirlpools, and cascades.

Formerly this Chilcoot pass had been monopolized by the Chilcoot Indians, who did not even allow the Chilcats — almost of the same blood — to use it: these were thus forced over the Chilcat route, which has an irksome portage of twelve or thirteen days to the head of the Tahk River (*Tahk-heen-a* of the Chilcats), a branch of the Yukon about half the size of the parent stream where it empties into the latter. Both of the bands on the upper Lynn Channel have united in keeping back the migration of the interior Indians to their waters in order to monopolize this trans-montane commerce. However, of late years, not only have the Chilcats used the mountain-pass of the Chilcoots, but both have allowed the *Tahk-heesh* or 'Stick' Indians of the interior to visit their own domain. I employed some of

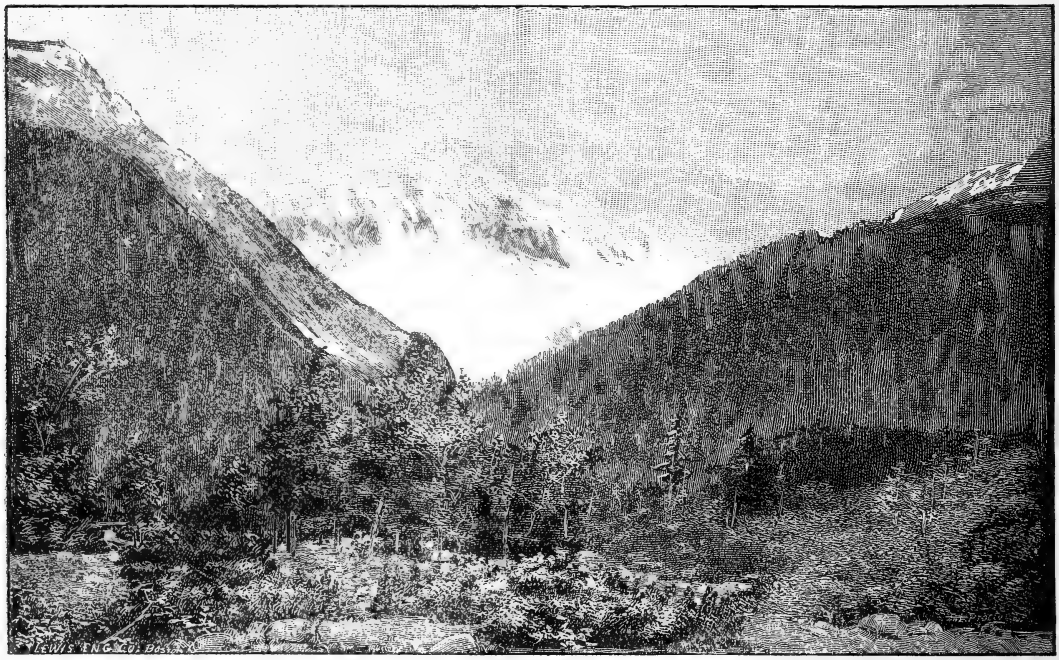
[1] Explorations and surveys from Chilcoot mission, Alaska, to old Fort Selkirk, British America.
[2] Department of the Columbia, headquarters, Fort Vancouver, W.T.; Brevet Major-Gen. Nelson A. Miles, commanding.


PART 1
OF THE
MAP OF THE ROUTE
OF THE
Military Reconnaissance
OF 1883,
Lieut. F. SCHWATKA, Comdg.,
From Chilcoot Inlet, Alaska, to
Ft. Selkirk, B. C.
SURVEYED AND COMPILED
BY
C. A. HOMAN, TOPGL. ASST., U. S. A.
GEOGRAPHICAL MILES
16 12 8 4 0 8 16
STATUTE MILES
16 12 8 4 0 8 16
Pelly R.
Ft. Selkirk
Graves
INGERSOLL ISLANDS
Indian Village
VALLEY OF VON WILCZEK
HOOT-CHE-KOO BLUFF
Rink Rapids
Tatchun R.
Tantalus Butte
Eagles Nest
Daly River
Nordenskiöld River
D'Abbadie River
SEMENOW MTS.
GRIZZLY BEAR BLUFF
Red Butte
Maunoir Butte
Newberry River
HANCOCK HILLS
RICHTHOFEN ROCKS
Tahk-heen-a River
HAECKEL HILL
4,000
Miles' Cañon
Rapids and Portage
Rapid
Yukon River
Mc Clintock R.
Michie Mt.
4,100
House
WATSON VALLEY
Carribou Crossing
Wheaton R.
L. Nares
Lake Bove
Perthes Pt.
Lake Tahko
Tahko R.
Bove Bay
Richard's Rock
Prejevalsky Pt.
Bennett
Homan R.
IRON CAPPED MTS.
Payer Portage
Cape Koldewey
Lake Lindeman
KOTUSK MTS.
Saussure Glacier
Glacier
Perrier Pass 4,100
Baird Glacier
Head of Canoe Navigation
Ferebee Glacier
Chilcoot L.
Mission
Chilcat Inlet
Pyramid Harbor
WHITE MTS
CHILCOOT MTS.
138° 137° 136° 135° 134° 133°
63° 62° 61° 60° 59°

all these three Indian tribes in my passage through their country.

Reaching Chilcat on the 2d of June, I found, as I had surmised from reports, that miners had pioneered the way some distance down the river in search of gold; but no one seemed to be much the wiser regarding the route, except that, as near as could be gleaned, they confirmed to a great extent the old Indian stories. My suggestion of a raft as my means of conveyance was ridiculed by whites and natives; and they could hardly conceal their contempt when the programme was known to be the passage, that summer, of the whole length of the river. Two or three hundred miles of tortuous lakes and a number of rapids, aggregating eight or ten miles in length, which the Indians never essayed, and around which the miners dragged their whip-sawed boats, were reported to exist, and supposed by all to be sufficient to wreck the raft theory of transportation; and, by the time I started, I felt very anxious myself regarding my plan.

We left on the 7th of June from Chilcat, with thirteen canoes, towed by a steam-launch kindly placed at my disposal by Mr. Spuhn, manager of the North-west trading company. At Chilcoot mission, four or five canoes were added to the already long chain, and the course resumed. Leaving Chilcoot Inlet, we entered another, that the Indians call the Dayay, an exact image of the fiord-like inlets characteristic of this part of the Alaskan coast; that is, having more the appearance of a large river than a salt-water estuary, its sides being immense precipitous mountains, covered three-fourths of the way to the top with a dense growth of spruce, fir, and pine, the latter holding to the lower levels, and capped with blue and white glacier ice that feeds innumerable and picturesque waterfalls coursing down the mountain sides. The mouth of the Dayay was reached that evening, our load of three or four tons lightered to the shore, the canoes and the bundles assorted and given to the different Indian packers, numbering over sixty. The packs varied from thirty-six to a hundred and thirty-seven pounds in weight, the adults generally carrying a hundred pounds, and the boys according to their age and strength. Here was found a small camp of

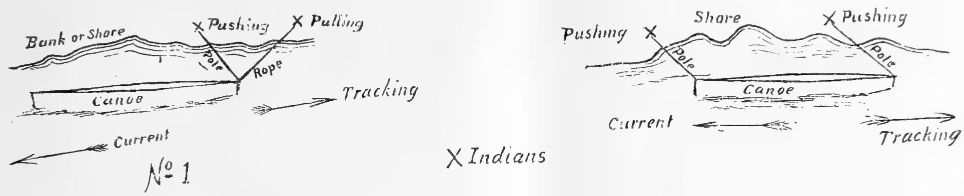


DAYAY VALLEY, LOOKING UP THE NOURSE RIVER VALLEY.

A glimpse of Baird Glacier covered with fog is given. The mountains holding the glacier being twice as high as the one shown on the left, their crests, if they had been visible, would not have shown in the photograph from which this illustration is made, being above the line where it is cut off. The lower edge of the fog-bank is just below the upper edge of the glacier. It is only at night that the fog-banks lift, when it is too late to take photographs.

Tahk-heesh Indians who were hunting black bear, said to be very numerous in this vicinity. During the evening we could hear many hooting-grouse (Bonasa Sabinii) in the spruce woods of the hillsides, this part of the day seeming to be their favorite time for this strain. I could but notice the very peculiar expressions of surprise given by the Chilcat Indians. Whenever one sets up a 'Ya-a-a!' at any thing that attracts his notice, especially the ludicrous mishap of a companion, every one in hearing, from two to two hundred, joins instantly; and a prolonged shout goes up that would astonish one not used to it. This may be repeated a number of times in a minute; and the suddenness with which it commences and stops is astonishing, and strongly reminds one of a gang of coyotes howling, or the baying of Indian dogs, from which I think they have borrowed it.

The head of canoe navigation on the Dayay is ten miles from the mouth of the river, although fully fifteen are travelled by the canoemen in ascending its tortuous course. They 'track' against the current in two ways, two persons being necessary for each method for a single canoe. The diagrams above will show these methods without further explanations.

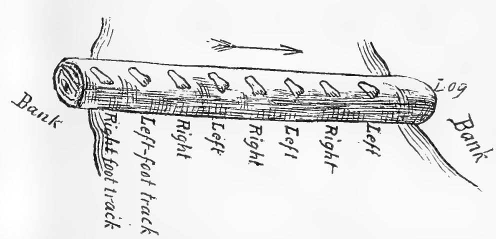


METHODS OF TRACKING A CANOE UP A RAPID.

The current of the Dayay is very swift, and it often takes two days' 'tracking' over the navigable part. Every few hundred yards or so the river has to be crossed, and oftentimes a hundred yards is lost in this undertaking. From the head of canoe navigation on the Dayay to the point where the Indian packers left the party is twenty-six miles, or the true length of the portage. Two miles and a half beyond the head of canoe navigation the Cut-lah-cook-ah of the Chilcats comes in from the west. This is really larger in volume and width than the Dayay, the two averaging respectively fifty and forty yards in width by estimation. I shortened its lengthy name, and called it after Professor Nourse of the U. S. naval observatory. Large glaciers feed its sources by numerous waterfalls, and its cañon-like bed is very picturesque. Both the Nourse and Dayay, like most streams fed by glaciers, have their waters noticeably white and chalky. Not a 'bite,' nor a 'rise,' could be had in either with bait or flies, although the Indians catch trout in them in their fish-wears.

At the head of the Nourse River the Indians say there is a very large lake. Its westward-bounding mountains are capped with an immense glacier, that could be traced along their summits for probably ten or twelve miles, and was then lost in the lowering clouds that these icy crowns form from the moisture-loaded atmosphere of the warm Pacific.[1] These light fogs are frequent in the warm days, when the difference of temperatures at the upper and lower levels is more marked, clearing up at night as they approach each other.

The march of the 10th of June was a very rough, fatiguing one of about ten miles, consuming from 7.30 A.M. till 7.15 P.M. It brought us to the foot of the mountain pass on the other side of which we should find the sources of the Yukon. I noticed that day that all my Indians, in crossing logs over streams, always turned the toes of both feet in the same direction (to the right), although they kept the body square to the front, or nearly so, and each foot passed the other at every step, as in natural walking. The advantage to be gained was not obvious to the author; as the novice, in attempting it, feels much more unsafe than in ordinary walking. Every evening was spent by the Indians in their gambling games, their orgies

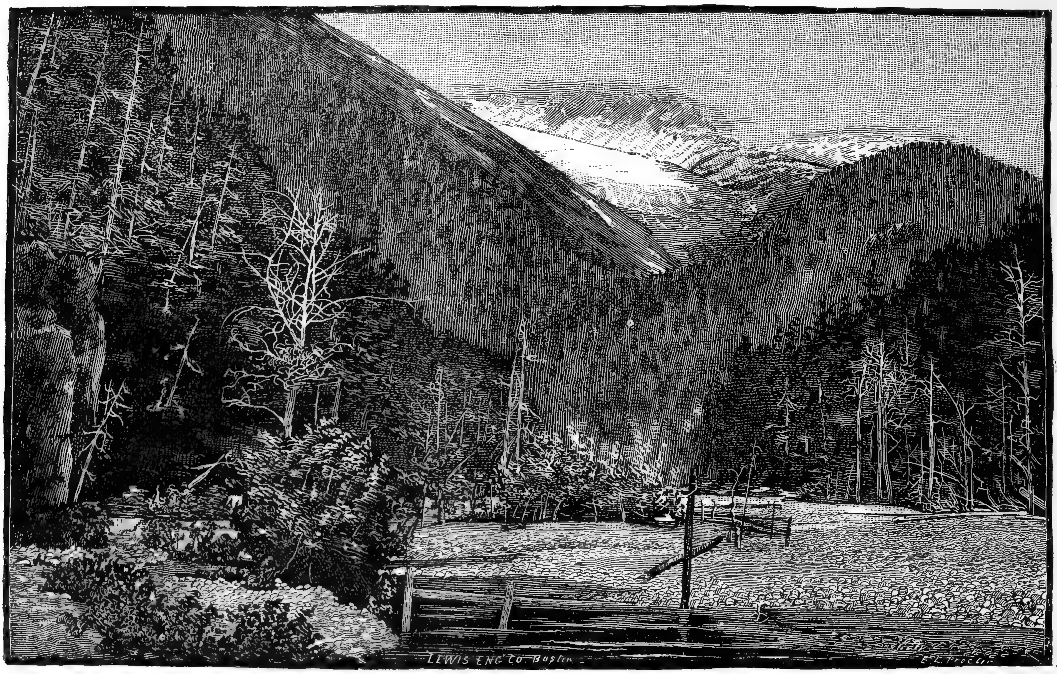


POSITION OF THE FEET IN WALKING A LOG, AS PRACTISED BY THE ALASKAN INDIANS.

[1] This glacier (see illustration, p. 222) was named after Prof. S. F. Baird of Washington, D.C.

often continuing until midnight or past. This, added to their rapidly improvised birchbark hats with pictures upon them that would prohibit their being sent through the mails, does not speak well for missionary efforts among them.

On the 11th we crossed the pass (Perrier Pass), ascending to forty-one hundred feet above the sea-level, being among the clouds formed by the glaciers in the upper third of the ascent. It was the usual severe alpine climbing; the agility and endurance of the Indian packers, with their immense loads, almost surpassing belief. The entire distance of six or seven miles was on the deep snow, the depth of which could only be inferred. Once through the Perrier Pass, the descent is rapid for a few hundred feet to a lake of about a hundred acres in extent, which was yet frozen over and the ice covered with snow. It very much resembled some old extinct crater, and I doubt not but that it was active in ancient times. Here there was no timber, nor even brush, to be seen; and the gullies of the granite hills, and the valleys deeply covered with snow, gave the whole scene a decidedly arctic appearance. My Indians, in following a trail on snow, whether it were up hill, on a level, or even with a slight descent, always stepped in each other's tracks, so that my large party made a trail that looked as if only five or six had passed over; but, when going down a steep descent, each one made his own trail, and they scattered out over many yards. I could not but be impressed with the idea that this was worth considering in estimating their numbers under such circumstances. From the little crater-like lake at the very head of the Yukon, the trail leads northward through a valley that converges to a gorge; and while on the snow in this we could hear the water gurgling under the snow bridge on which we were evidently walking. Farther on, where these snow arches were too wide, they had tumbled in, showing in many places deep perpendicular snow-banks, oftentwenty to twenty-five feet in height. Passing by a few small lakes on our left, some yet containing floating ice, we caught sight of the main lake late in the afternoon, and in a few hours were upon its banks. It is a beautiful sheet of water, ten or eleven miles in length,[1] and looked not unlike a limited area of one of the broad inland



A VIEW IN THE DAYAY VALLEY.

A finger of the Saussure Glacier is seen peeping round the mountain, the rest being covered with fog.

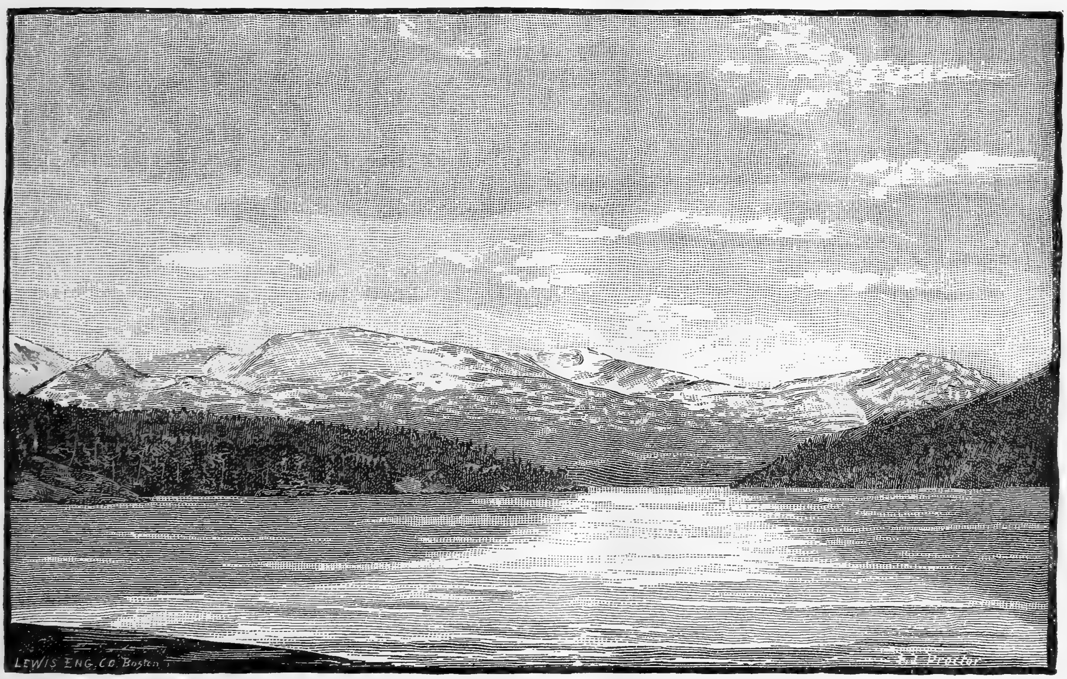
[1] Named in honor of Dr. Lindeman of the Bremen geographical society.

passages traversed by the steamers plying to Alaskan ports farther south. Fish were absent in these glacier-fed streams and lakes, but we managed to kill a few dusky grouse (Tetrao obscurus) and green-winged teal (Nettion carolinensis) to vary the usual government ration; but all were tough beyond measure, it being their breeding-season. Over Lake Lindeman were seen sea-gulls and the graceful little arctic tern that I recognized as an old and garrulous companion. Of large game, a small black bear cub was the only thing seen; although mountain goats were abundant a short distance back in the hills, one having been seen by us in the Perrier Pass.

The next day we commenced building our raft on Lake Lindeman; although the logs were very small, consisting of dwarfed spruce and contorted pine. Fifteen by thirty feet was considered large enough until we commenced to load it, when we were forced, during a heavy gale on the 15th, to send it ahead with but half a load and three men, the remainder of the material being stowed in two dilapidated wooden canoes, — fair samples of the very few that exist from here until old Fort Selkirk is reached, where birchbark canoes commence. The remainder of the party took a whole day in struggling overland through the tangled brush and marshes of the gullies, and climbing the steep, smooth granite banks that separate them from the ridges covered with a labyrinth of fallen timber.

At its northern end Lake Lindeman is drained by a small river fifty to sixty yards in width, full of rapids and cascades, and about a mile in length, where it empties into a large lake that I named after Mr. James Gordon Bennett, a well-known patron of American geographical research.

The raft was shot through the connecting river, June 16, and the dimensions enlarged to fifteen by forty; although, counting all projections, it really came nearer sixteen by forty-two. Around this series of rapids the Indians portage their effects on their backs; and I named it Payer Portage, after Lieut. Payer of the Austro-Hungarian expedition of 1872–74. By the 17th of June, at midnight it was light enough to read print like that of *Science*, and continued so through the month, except on very cloudy nights. Har-



LAKE LINDEMAN.

The view is taken from the upper (southern) end of Payer Portage, looking (south) toward Kotusk Mountains. Perrier Pass is on the extreme right wrapped in fog. There are higher ice-capped mountains in the distance, not shown here.

lequin ducks were noticed on the southern end of Lake Bennett, and black and brown bear and caribou tracks in the valley of a small stream emptying into the lake near by. A couple of Tahk-heesh Indians were here encountered, one of whom stammered considerably. Among my Chilcat packers I also noticed one that was deaf and dumb, and two or three afflicted with cataract in the eye. On the 19th of June we commenced traversing Lake Bennett. Through the ice-fields capping the timbered mountains to the east of the lake protruded a great many dull red rocks and ridges, specimens of which, found in the terminal moraines of the little glaciers putting down the gulches, showed iron; and I named this bold range the Iron-capped Mountains. By three P.M. it was blowing a gale; and by five the waves were washing over our raft, and threatening to tear it to pieces, for there was not a single log that extended the whole length of the raft proper. We accordingly put into a cove, where we obtained four large spruce to strengthen the raft, and on the 21st resumed the journey, reaching the northern end of Lake Bennett that evening. The lake is thirty miles long, and flanked by precipitous hills three thousand to thirty-five hundred feet high, capped with glaciers. At its north-western face there come in a couple of streams, forming a wide, flat, and conspicuous valley that we all felt sure was going to be our outlet as we approached it. Several well-marked buttes spring from this valley, giving it a very picturesque appearance; its largest river being sixty to seventy-five yards wide, but quite shallow. I called it Watson valley, after Professor Sereno Watson of Harvard.

The draining river of Lake Bennett is about two hundred yards wide, and is called by the Tahk-heesh, 'the place where the caribou cross;' these animals, in their migrations, fording its wide, shallow current, and passing out and in through Watson valley. It is hardly two miles long before it expands into another lake, whose general course now turns to the east; and our old friend, the steady, summer south wind, was of no avail for sailing our huge craft. Although this lake (Lake Nares, after Sir George Nares) was but three or four miles long, its eastern trend kept us three days before we got a favorable wind, the banks not being good for tracking. Although small, Lake Nares was one of the prettiest in the lacustrine chain. The country was perceptibly opening; and trap, granite, gneiss, and metamorphic and eruptive rocks generally, were giving way to the sedimentary and fragmental. Many level places were appearing, the hills were less steep, and the snow disappearing from their crests. Roses of varying hues were in bloom, and also wild pansies; while wild onions lined the lake-shore in profusion, and everywhere there was a general change of verdure, and variation for the better. Grand terraces in beautiful symmetry on the two sides of the lake plainly showed its ancient and subsiding levels. These, too, — in a less conspicuous manner, however, — had been noticed on the northern shores of Lake Bennett. Lake Nares drains through a short river of a hundred yards into another lake[1] about eight miles long, and on whose limited shore-line I was compelled to make two camps and a half-dozen extra landings, so baffling was the wind on which we had to depend. Two bungling side-oars on the huge raft allowed us to make about a half a mile an hour with laborious effort, a wall-tent for a sail driving us along as fast as two miles and a half under the most favorable wind. An oar on the bow and stern gave us steering apparatus, and a dozen strong wooden poles served us as pries over many a lake and river bar of sand, gravel, and mud.

During one of these temporary landings on the shores of Lake Bove, some of my Indians set fire to the green spruce-trees by a large blaze kindled under them, and a dense volume of smoke ascended high in the heavens. Late that day a smoke was seen north of us some ten or fifteen miles away, and our Indians told us it was an answer to the one they had accidentally made that morning. These signal-smokes between the two bands were formerly quite common; the Chilcats thus heralding to the Tahk-heesh that they had crossed the Kotusk Mountains, and were in their country for trading purposes. Not many years ago, as I was told by an old Hudson-bay trader in these parts, this Chilcat-Tahk-heesh trade has been known to be so great that not less than seventy-five or eighty of the Chilcats and Chilcoots crossed the mountains twice annually, each carrying a hundred pounds of trading-material, or a grand total of eight tons, to be exchanged for furs that were collected from a wide circuit by intertribal commerce. Fort Selkirk, established by the Hudson-bay company near the junction of the Pelly and Yukon, interfered with their trade for a brief period, until 1851, when a war party of Chilcats extended their trading-tour nearly five hundred miles in order to destroy it; and its blackened chimneys still attest their success.

Lake Bove has a deep bay in its southern

[1] Lake Bove, after Lieut. Bove of the Royal Italian navy.

face; and into this, our Indians reported, empties a large river. Rounding Point Perthes (after Justus Perthes of Gotha), nearly white with its covering of limestones, some of them almost true marble in their brilliancy, we enter Tahko Lake, eighteen miles in length by our measurement (forty-five, according to one guess on record). A well-deserved remark regarding conjectural geography in order to 'fill out' maps, charts, or books, I hope will not be found amiss at this point. In one of these we were given to understand that from here the Indians make Fort Selkirk in a day and a half in their birchbark canoes. There are no birchbark canoes used on the lakes, nor as far as Selkirk. The very few Indians living on the four hundred and thirty-three miles between Tahko and Selkirk never stay in their cramped wooden canoes over six hours during a day, and would therefore have to paddle over each mile at the rate of one minute and thirty-five seconds.

Tahko Lake receives a small stream on the south, which, followed up, leads to one of the mountain passes that debouch upon the waters of the Pacific, so said our Indians. The same authorities gave us to understand that it drains smaller lakes, and has a smaller bed than the rivers and lakes through which we had passed; and its appearance, as we sailed by, seemed to confirm their opinions, thus showing that we had been on the main stream, or the Yukon proper.

(*To be continued.*)

FLOODS IN THE OHIO.

No river of the same magnitude fluctuates in depth so much as the Ohio. Twice, or oftener, during most years, the river rises at Cincinnati to a stage of forty-five feet six inches by the gauge at the water-works, when the occupants are compelled to vacate the premises at the foot of Commercial Row. A greater depth than this is a flood, and occasions more or less loss and suffering. Extreme low water is two feet, and extreme high water of February, 1883, was sixty-six feet four inches, — a difference of sixty-four feet four inches.

The gauge at the water-works was fixed in 1858, and all observations since then are referred to that standard. This gauge is intended to show the depth of water on two principal bars near Cincinnati, — Four-Mile bar above, and Rising-Sun bar below, the city. All observations of the stage of water of which we shall speak have been reduced to this gauge.

We may mention the noted floods preceding the establishment of the gauge in 1858.

1774. — It is traditional that at about this year there was a great flood in the Ohio. Vol. i. p. 343, of the *American pioneer*, states that two white hunters were detained some time in March of this year at the mouth of the Big Kanawha by a remarkably high freshet, which, from fixed marks on Wheeling Creek, is supposed to have been equal to that of 1832.

1789. — Various records show that there was a remarkable flood this year observed by the first white settlers, which must have been of much longer duration than any of later date.

1792. — It is within the recollection of some now living, that four years after the settlement of Losantiville (Cincinnati) there was a flood that covered the land on which Columbia now stands. The stage of water must have been sixty feet or more.

1815. — Another great flood occurred this year, but it was of less magnitude than that of 1792.

1832. — There are several points in Cincinnati where permanent high-water marks were made on Feb. 18, 1832; and they almost exactly agree in showing that the stage of water was then sixty-four feet three inches. The population of Cincinnati was then twenty-eight thousand; and, as the city was situated upon the river-bank, nearly the whole of it was inundated by a flood, which increased continually for ten days.

1847. — Cincinnati contained about ninety-six thousand people at this date. The river began to rise on Dec. 10, and on the 17th reached sixty-three feet seven inches.

The following table records the highest stage of water at Cincinnati each year since 1858, as well as those just given for 1832 and 1847: —

Year.	Date.	Feet.	Inch.	Year.	Date.	Feet.	Inch.
1832	Feb. 18,	64	3	1871	May 13,	40	6
1847	Dec. 17,	63	7	1872	April 13,	41	9
1858	June 16,	43	10	1873	Dec. 18,	44	5
1859	Feb. 22,	55	5	1874	Jan. 11,	47	11
1860	April 16,	49	2	1875	Aug. 6,	55	5
1861	April 19,	49	5	1876	Jan. 29,	51	9
1862	Jan. 24,	57	4	1877	Jan. 20,	53	9
1863	March 12,	42	9	1878	Dec. 15,	41	5
1864	Dec. 23,	45	1	1879	Dec. 27,	42	9
1865	March 7,	56	3	1880	Feb. 17,	53	2
1866	Sept. 26,	42	6	1881	Feb. 16,	50	7
1867	March 14,	55	8	1882	Feb. 21,	58	7
1868	March 30,	48	3	1883	Feb. 15,	66	4
1869	April 2,	48	9	1884	Feb. 14,	71	$\frac{3}{4}$
1870	Jan. 19,	55	3				

The flood-stage of 1875 was remarkable as occurring in summer, when the river is in most years low.

The great flood of 1883 was of unprecedented magnitude, and so great a rise was entirely unexpected. The stage of water had not exceeded sixty feet for thirty-seven years. By it the whole of those parts of Cincinnati and the towns on the opposite side of the river — Covington, Newport, and Dayton, Ky. — located nearest the water were inundated. In Covington, in all, perhaps 350 houses were submerged. In Newport not less than 2,100 houses were flooded. In Dayton and Bellview, Ky., over 400 houses were under water.

In Cincinnati, travel on many of the street-car lines was suspended; nearly all the freight and passenger depots were submerged; all but two of the railroads stopped running; fifteen of the largest coal-yards were under water; and the gas-works suspended, leaving the city in darkness. More than 1,500 business-houses, and nearly 3,700 dwelling-houses, were inundated, causing more than 2,400 people in Cincinnati alone to become objects of charity, for whom shelter, covering, clothing, and food must be provided.

It is within bounds to say that one-tenth of the population in and around Cincinnati needed assistance of this kind. The Associated charities superintended the distribution of aid to those suffering. From Feb. 12 to March 5 this organization relieved 5,260 families, or 24,111 persons. It issued 105,141 rations, and supplied 2,046 families with clothing, 1,916 families with bedding, and 647 families with coal. It also distributed 3,991 pairs of boots and shoes.

The pecuniary losses that resulted from this flood can never be precisely known, but it has been estimated that along the two thousand miles of shores inundated it aggregated sixty millions of dollars.

The town suffering most in proportion to its size was Lawrenceburg, Ind., which was completely inundated. It is so situated that at this stage of water the Miami River runs directly through the town, pushing houses from their foundations, and sweeping away every thing movable.

The flood was due to two storms, — the first from Feb. 3 to 6, in which about 3.5 inches of rain fell at Cincinnati; and the second on Feb. 10 and 11, in which the rainfall was about 2 inches. These storms extended to the head waters of the Ohio, and fell upon frozen ground; so that the water could not soak into the earth, but was carried at once into the water-courses.

The flood of 1884 arose from a single storm on Feb. 4 to 6, in which the precipitation was unusual in amount and rapidity, being as much as 4.46 inches in eight hours less than three days. This storm, combined with the warm weather, caused a general thaw over all the region from which the feeders of the Ohio come, and sent large volumes of water into the rivers, besides the immediate rainfall.

When we consider what an unusual combination of circumstances is necessary to cause a stage of water exceeding sixty feet, and that such an occurrence cannot be ordinarily expected more than about once in a quarter of a century, it appears most remarkable that two such floods should happen in successive years.

A WOMAN'S JOURNEY TO THE KARAKORUM VALLEY.

MADAME UJFALVY, who recently accompanied her husband to Kashmir and Baltistan, has published an interesting and lively account of the glacial region of the Himalayas, which she was the first European woman to penetrate. In the village of Shamba, in the Kulu country, on the occasion of a ceremonial visit to the temple by the rajah, it is customary for the priests to sacrifice a she-goat. Once undertaken, the priests may not eat until the sacrifice is complete; and the assent of the animal to its own death, without which it may not be killed, is supposed to be indicated by a trembling of the body. The unconscious creature is not always in a trembling mood; and to induce the same the priests squirt cold water into its ear, which usually has the desired effect. On one occasion, the authoress relates that even this failed, and the goat, outraged by such treatment, escaped to the rugged mountain side, and, even after recapture, refused to gratify its captors. Put to their wits, the priests finally plunged it bodily into the icy mountain stream which dashes through the village. Taken out again, it naturally trembled with its whole body; and the sacrifice was finally completed to the satisfaction of all, especially of the priests, who had already imagined themselves perishing of famine.

Srinagar, capital of Kashmir, sometimes known as the oriental Venice, seemed less attractive than report had made it. The streets were narrow canals of stagnant and offensive water, in which swarms of ragged people disported themselves. Dirt was too evident to be ignored. Only when evening set in, and all contrast disappeared under the moonlight, did this singular and sombre town seem to harmonize with the magnificent mountains which surround it. There are some hundred thousand inhabitants; and, besides the finest quality of shawls, they produce the finest and most artistic work in silver and copper. The passage to Baltistan from Srinagar traverses a singular plateau fourteen thousand feet above the sea. The earth is bare, and undulated as if in waves. It is the bed of an extinct glacier, and surrounded by mountains, between which the wind rages, rendering it passable only in the three summer months. Even in

September, snow-hurricanes may destroy rash travellers. Though English authorities had informed them that rain was impossible on this plateau, the party were drenched. Marmots and bears alone inhabit this solitude. Grass is rare, and, at one place where abundant, is said to be poisonous for animals. These regions offer a desolate grandeur, unsoftened by vegetation.

The descent to Baltistan and the sources of the Indus was through scenery equally wild and melancholy, so that the first signs of cultivation met the eye as grateful relief.

The Baltis are Mussulmans, and chiefly remarkable for their devotion to the game of polo; which, in fact, originated here, and for which their well-trained, tough little mountain ponies are admirably adapted.

Their capital is Skardo; but the purest type of the race is found in the Shigar valley, which contains the largest glaciers in the world after those of Greenland, and the highest mountains in the world after Mount Everest. The glaciers form an unbroken line for nearly a hundred miles. Mount Dapsang of the Karakorum range is only some two hundred feet lower than Mount Everest. But even here the Shigar River waters an attractive oasis of some six miles in extent, with fields of millet and beans, and orchards weighed down with fruit, among which nestle tombs, mosques, and picturesque though uncomfortable habitations. The apricots and melons of this region are delicious.

The party returned by another and very difficult route, which followed all the windings of the Indus; yet here and there little villages were set, like verdant nests, among the rocks. In spite of the incessant conflict with nature, which a residence here entails, the people are devoted to their country, and prefer it to any other.

The journey to Shigar was due to the munificence of the Maharajah Rambir Singh of Kashmir; and its scientific results, which remain to be published, are believed to be important.

THE ARTIFICIAL PRODUCTION OF RAIN.

In his anniversary address delivered to the Royal society of New South Wales, Mr. H. C. Russell, the president and government astronomer, deals at some length with the subject of producing rain artificially. He begins with a few points in its history, telling first how Arago, finding the practice of firing guns common in some of the departments of France, had tried to trace the origin of the custom, which probably began in 1769. A retired naval officer, who at sea had seen water-spouts destroyed by cannon shots, made his home in a district that suffered from violent rain and hail storms, and determined to try the power of shot and shell upon these new foes; and, setting up his battery, his success was such that the district was protected from the violent storms. The practice became popular in France; and up to the year 1806, and even later, many communes kept a battery of small guns for this purpose, the commune of Fleury even going so far as to get a cannon which used a pound of powder at each discharge. Arago could not trace what the effect had been, but he at least was not convinced that it had had any good effect; and after a time the practice became obsolete. Volta's biographer says that "it is well known that Volta thought a possible advantage might be found in having large fires during thunder-storms;" his reason probably being, that the smoke would serve as a conductor for the electricity, and so prevent dangerous discharges.

To test the effect of the discharge of artillery on the weather, Arago examined the weather-record of the Paris observatory for many years, especially for the days adjacent to those on which the regular gun-practice took place in the fort, situate somewhat less than two miles from the observatory. The firing took place at this fort on certain days in the week, from seven to ten A.M., about one hundred and fifty shots being fired. Arago found, that, out of 662 days preceding the practice, 128 were cloudy; out of 662 days of practice, 158 were cloudy; out of 662 days following practice, 146 were cloudy; which he regarded as proof that the discharge of heavy artillery does not seem to have the effect of dissipating the clouds.

Struck at one time by the amount of destruction caused by hail-storms, Arago proposed drawing off the electricity by means of wires carried up to great elevations by captive balloons; but, when he came to the practical consideration of the scheme, it was soon seen that each balloon would not protect more than, perhaps, a thousand square yards, — a mere speck of France. In later years he was led to doubt the value of such a means of protection.

Arago relates, that, in tracing the history of the use of cannons, he found that bells, and especially church-bells, had preceded them; and it was at one time firmly believed that the vigorous ringing of church-bells was sufficient to dissipate dangerous storms. Mr. Russell finds that up to 1810, or later, the idea was popularly prevalent that storms might be destroyed or prevented by fire or guns; and he thinks that a complete change to the opposite opinion has taken place since then. He says, —

> "Australia, like Africa, wants the rain-doctor to make rain, not drive it away. It is not only in Australia, however, that the belief in the artificial production of rain exists. In America, during the civil war, it was a matter of common observation that rain followed the great battles; and the belief in this became so general, that farmers began the practice of making large heaps of brushwood on each farm, and, when they wanted rain, lighting them all together. I cannot find any reference to the results of this system in the Smithsonian publications, in which almost every subject of this kind is dwelt upon; but the practice seems to have been given up."

Mr. Russell then alludes to the well-known little volume by Mr. Edward Powers, published in 1870, and entitled 'War and the weather, or the artificial production of rain;' and to the review of this book in *Silliman's journal*, inclining to the opinion that great battles do exert some influence in the production of rain, but failing to accept Mr. Powers's incom-

plete discussion of the facts as proof. He turns next to Espy's conviction, that rain might be produced economically whenever it was wanted, and cites Professor Henry's opinion in the matter: —

"I have great respect for Mr. Espy's scientific character, notwithstanding his aberration, in a practical point of view, as to the economical production of rain. The fact has been abundantly proved by observation, that a large fire sometimes produces an overturn in the unstable equilibrium of the atmosphere, and gives rise to the beginning of a violent storm."

The opinion of Professor Everett, president of the Meteorological society, is also cited. He believed that great battles and great fires tend to produce rain, but that rain does not, of necessity, follow battles or fires.

The climate of Australia being peculiar, Mr. Russell has endeavored to collect the records bearing upon the question there; and, there having been no battles (except a mimic one, which produced no rain), he passes to an examination of the meteorological conditions of the times of the great fires which have occurred in Sydney since 1860, and assumes, that, if a fire produced rain, it would fall within forty-eight hours. His record embraces forty-two large fires (including two serious explosions), extending over a period of twenty-one years; and he concludes that there is not one instance in which rain has followed within the forty-eight hours as an evident consequence of the fire.

In cases where it is asserted or believed that rain has been produced artificially, it would be interesting to examine whether the rain was due to the fires or to ordinary meteorological changes. While it is evident that some of the most competent authorities in England and America think that under certain circumstances rain may be produced artificially, Mr. Russell thinks they all carefully avoided saying what the circumstances were; and he proceeds to develop some idea of what they are, from a consideration of the natural conditions under which rain is deposited, and adducing certain instances as illustrations, from nature, of the conditions under which the leading scientific meteorologists of the day tell us that rain is formed. He says, —

"If we can get a measure of these [observed] effects, it will serve as a guide in estimating what would be required to make rain. At Sydney the average relative humidity is 73, and at Windsor it is rather less; and we have just learned that such atmosphere lifted from Windsor to Currajong, 1,800 feet, deposits 60 per cent more rain. If we could make it rise up over Sydney 1,800 feet, we might fairly expect to get 60 per cent more rain. Now, a wall built 1,800 feet high, and of considerable length, so that a wind would not divide and go round it, but go over, would have the desired effect; i.e., to lift the air and cause rain: but any thing that would do this would serve the purpose, and it may be done by fire; but of course the fire must have the effect of lifting the atmosphere up. It will not do for the products of the fire to rise up slowly, mixing with the air, and making it drier as they rise. If it is to have the effect of a wall, — that is, making the whole of the air passing over rise up 1,800 feet, — it must act as an explosion would do, suddenly, or by a constant uprush of such violence that it would rise up 1,800 feet. The force necessary to do this is easily computed, and we can in this way get a money value for the work to be done. At Sydney the average velocity of the wind is 11 miles per hour; and all the air passing over is to be lifted, and the weight of it on the surface is, say, $14\frac{1}{2}$ pounds on the square inch, and $13\frac{1}{2}$ pounds at 1,800 feet high. At least, for our present purpose, these figures are sufficiently exact. The average weight to be lifted, therefore, is 14 pounds on the square inch. The fire must have the same length as the proposed wall, for the same reason, and a breadth equal to the forward motion of the air in a given time. We have therefore to lift a weight of 14 pounds on the square inch over a surface of 1,000 feet by 10 miles (52,800 feet), and raise it up 1,800 feet every minute. To do this we will assume that coal is employed, and that, as it is burnt in the air, the whole of its heat will be effective. The mechanical equivalent of good coal is 14,000,000 foot-pounds for each pound of coal used. We have, therefore, —

$$\frac{14 \times 12 \times 12 \times 1{,}000 \times 1{,}800 \times 52{,}800}{14{,}000{,}000 \times 112 \times 20} = 6{,}110 \text{ tons per minute} =$$

8,800,000 tons in a day, or nearly 9,000,000 tons of coal per day, to increase the rainfall 60 per cent, at a cost, at 10s. per ton, of £4,500,000.

"Of course this is only a theoretical experiment, and ignores all the heat lost by radiation and imperfect combustion; but it serves to give some idea of what is necessary to disturb the course of nature, and, I think, shows how utterly futile any such attempt would be, even near the sea, where the air is moist."

It would seem unreasonable, Mr. Russell concludes, to hope for the economical production of rain under ordinary circumstances; and our only chance would be to take advantage of a time when the atmosphere is in the condition called unstable equilibrium, or when a cold current overlies a warm one. If under these conditions we could set the warm current moving upwards, and once flowing into the cold one, a considerable quantity of rain might fall; but this favorable condition seldom exists in nature.

ROTATION OF JUPITER.

MR. W. F. DENNING has recently published an investigation of the rotation of certain spots on Jupiter which confirms in a remarkable degree a theory already propounded that this planet resembles the sun in not only rotating in different times in different latitudes, but in having the period of rotation of its equatorial region shorter than that of regions in middle latitude. From the red spot which has formed so conspicuous an object on the planet for nearly five years, the following rotation periods are obtained at different times: —

Interval.	Number of rotations.	Period of rotation.
		h. m. s.
1880, Sept. 27–1881, March 17	413	9 55 35.6
1881, July 8–1882, March 30	640	9 55 38.2
1882, July 29–1883, May 4	674	9 55 39.1
1883, Aug. 23–1883, Dec. 5	251	9 55 38.8

A gradual lengthening of the period is thus indicated. On the other hand, from a white spot near the equator the following times are obtained: —

Interval.	Number of rotations.	Period of rotation.
		h. m. s.
1880, Oct. 20–1881, Sept. 30	842	9 50 5.8
1881, Sept. 30–1882, Dec. 23	1,095	9 50 8.8
1882, Dec. 23–1883, Nov. 25	823	9 50 11.4

We thus have the paradoxical result that the rotation period is more than five minutes less at the equator than in the latitude of the red spot. The effect of the motion of matter from one part of the planet to the other would be to make the actual time of rotation longer as we approach the equator. The opposite effect noticed in the times of rotation of spots suggests the possibility that the latter may be endowed with a motion of their own; partaking, perhaps, of the nature of cyclones on the earth's surface.

RED SKIES A CENTURY AGO.

I VENTURE to suggest that recent phenomena are a re-appearance of those of 1783. It will therefore be interesting to give a sketch of the phenomena of 1783, in order to ascertain their similarities and differences.

In the spring of 1783 one of the greatest eruptions of Shaptar Jokul in Iceland resulted in the largest lava-streams ever observed, ten miles long, five miles wide, and a hundred feet deep. Obviously, great quantities of ash must also have been thrown up.

Towards the end of May, *höhenrauch* (dust-haze) was remarked first on the western coast of Europe. It was so thick as to render the sun invisible on the horizon, and even at mid-day it was only a red indistinct disk. It was first noticed, May 29, at Copenhagen, then in England, on July 6 and 7 in France, and rapidly spread over Europe, northern Africa, and eastern Asia. Neither rain, heat, nor cold dispelled it; and, having reached a maximum at the end of July, it remained visible till Sept. 26, 1783, at Copenhagen, thus lasting four months.

There are numerous instances of volcanic ash being carried very great distances. The dust from Coseguina in Central America was carried a hundred and seventy miles, towards Jamaica, and was so dense there as to darken the sky. Hence meteorologists concluded that the *höhenrauch* of 1783 was due to dust from Shaptar Jokul.

The similarity of the 1783 phenomenon with the present seems to me extraordinary. The frightful volcanic explosion of Krakatoa in the Sunda Straits, which began on Aug. 26, 1883, supplies, as did Shaptar Jokul, the material. The splendid redness at sunrise and sunset was first reported from India; and it will be an interesting inquiry to study the spreading of the phenomenon, as was done in 1783.

It was first seen in Japan at the end of August, but only reached Germany in November; and, from the dates of the various records, it seems evident that the ash was thrown into the upper regions of the atmosphere in the tropics. The extraordinary duration corresponds with that of 1783, and is to be explained by the fineness of the dust.

The differences are, that in our country the obscuration of the sun is less than in 1783, which would accord with the greater proximity of Iceland than Java.

It seems probable that rain and snow may bring some of the dust to the earth. I have therefore examined the residue of the rain-gauges from the 1st of December, but thus far without any positive results. Hence I infer that the dust is at present too high for it to be brought down: it is therefore most necessary that such observations be made in many places.

These views have been advocated by Lockyer, who, through spectroscopic research, has been led to the same conclusion.

Before, however, a final decision upon one or another hypothesis can be given, it will be necessary to collect observations, researches, and investigations, from as many points of the earth's surface as possible, which will doubtless be done in meteorological journals.

G. KARSTEN.

Kiel.

BROWNE AND BEHNKE'S VOICE, SONG AND SPEECH.

A practical guide for singers and speakers; from the combined view of vocal surgeon and voice-trainer. By Dr. LENNOX BROWNE and EMIL BEHNKE. New York, *G. P. Putnam's Sons*, 1884. 322 p., illustr. 8°.

A CAREFUL perusal of this work must establish the conviction in the mind of the reader, that the authors thoroughly understand their subject. In reference to voice-formation, many hitherto obscure points are made clear, and many hitherto doubtful points are settled, on physiological, and therefore indisputable, grounds. Thus, the distinctions between the various 'registers' of voice are proved to be due to demonstrable differences in the adjustments of the 'voice-box' and the vocal ligaments. A great deal of information is communicated on the subject of voice-cultivation, and the prevention and treatment of the ailments of 'voice-users.' The precepts in regard to hygienic habits for singers and speakers, their diet, and their clothing, so as to secure unrestricted freedom for the chest and the abdomen, are both judicious and important. About one-half of the book is taken up with the single subject of respiration. The proper management of the breath is shown to be a matter of the highest possible value to singers and speakers. The conclusions arrived at, in reference to the healthful and efficient use of the lungs, commend themselves as thoroughly sound and practical; but condensation in the treatment of the subject would have been a great improvement, as the same principles are again and again repeated under different heads.

The use of the laryngoscope is recommended more than will be thought generally advisable, so far as practical results are concerned; but the authors have handled this instrument to

good purpose in illustrating their descriptions of the larynx by photographs taken from the reflected images in the laryngoscopic mirror. Thus, the chink of the glottis is shown in the act of forming sound. Photographs are also given of the interior of the mouth, showing the positions of the soft palate during the singing of certain notes. These and other illustrations greatly add to the interest of the elaborate descriptions of the processes of phonation.

The book commences with a plea for the study of vocal physiology. The importance of a knowledge of the *principles* of vocal physiology to singers and speakers, no one will dispute; but it may be doubted whether any practical benefit can be derived by voice-users from the anatomical detail of the structure of the vocalizing-apparatus, which is here so copiously exhibited. This part of the treatise might have been much condensed with advantage, so far as its practical applications to speaking and singing are concerned. This portion of the book may, perhaps, have its utility to voice-*trainers*, who ought fully to understand the mechanism which they undertake to direct; but voice-users could not 'govern the ventages' in speech or song with any better effect from knowing the shape and name of the individual cartilages which they set in motion.

In the chapter on defects and impediments of speech, both stammering and stuttering — very indefinitely distinguished — are traced to one common source: "A fault in respiration is at the root of all the mischief." No system is presented or advocated for the relief of stammerers, for the specified reason that "there is none that is honestly applicable to all cases." Something more definite might have been expected under this head. For facts relating to the vocal registers, and to the anatomy of the larynx and the chest, this book will be useful as a work of reference in the libraries of scientific teachers of speech or song; but it will not add much to their knowledge of practical vocal physiology.

M'ALPINE'S BOTANICAL ATLAS.

The botanical atlas: a guide to the practical study of plants, containing representatives of the leading forms of plant-life, with explanatory letterpress. By D. M'ALPINE, F.C.S. 2 v. New York, *Century Company.* 1883. 52 pl. 4°.

IT is difficult to see why this work should be entitled '*The* botanical atlas' (except to distinguish it from the other atlases compiled by the author), since many of its best plates are from an entirely different treatise, which may as fairly lay claim to being called '*The* atlas;' namely, that of Dodel. Judging by its size, it is apparently designed to be used in class demonstrations; but its sumptuous binding somewhat unfits it for the laboratory table, while, on the other hand, the figures are not large enough to be used in place of lecture diagrams. The work is in two volumes, one of which is devoted to phanerogams, the other to cryptogams.

The drawings in the volume on flowering-plants are, for the most part, very good, some of them possessing remarkable clearness of outline; and the coloring is above the average in delicacy of effect. The impression made by this volume as a whole is, that it has received an amount of care which could have been more usefully expended in a slightly different direction. With the exception of the words 'magnified' and 'highly magnified,' there is nothing to serve as a guide to the relative size of the figures of corresponding parts. Every practical teacher of botany would have suggested to the compiler the desirability of furnishing what is never out of place in an atlas of any kind, to wit, a scale of parts. This is always serviceable in the treatment of microscopic or of any minute figures: in fact, without it they are often misleading to the beginner. It may be said, that it is impracticable to state in every case the approximate amount of enlargement or reduction; but certainly in most cases it is not impossible to give a hint as to the relative sizes of the figures.

Drawings of the size given in this atlas are chiefly useful for individual and not class study. With a greater enlargement, the plates would have proved useful in classes of ordinary size. A few attempts have been made to provide plates of suitable size for class use; but the subjects have not always been so well chosen, nor so successfully treated, as those in this volume. The well-known series made by Professor Henslow is so crowded that the effect of the exquisite drawing is obscured. In the lack of good wall-plates, we have a want which ought to be supplied. If the plates in the present volume were larger, so that they could be employed for demonstration before classes of moderate size, they would go far to meet this need. Their size now restricts their employment to the individual student, and this necessarily lessens their utility; but this is a matter for publishers to consider.

The volume relating to cryptogams contains twenty-six plates, some of which include a large number of figures copied from standard

authorities, a small number of the figures being original. The object seems to be quite as much to attract the eye by brilliant coloring as to furnish the student with accurately drawn microscopic details. The quality of the plates varies considerably: for, while those of Volvox and Mucor are effective, the same cannot be said of those of some of the lower forms, — as Nostoc, Oscillaria, Gloeocapsa, etc., — where a mass of color takes the place of clearness of outline, and important details are not well brought out. This may, however, be the fault of the lithographer, rather than of the original drawings. Considering their biological importance, better and more numerous figures of Myxomycetes might have been given. The plates of Fucus and Cetraria are unnecessarily bad, considering that there are several works from which excellent figures could have been copied; and the same may be said of the plate of Florideae, where no good figure of the procarp or cystocarp is given, and that of mosses, where the peristome is badly drawn. The antherozoid of a fern is represented not only without the usual bladder-like appendage, but also without cilia.

The text consists of brief descriptions of the figures, with directions for studying the objects themselves in the laboratory; the whole forming a skeleton to be filled out by the instructor. It seems to us that the use of the term 'gonidium' in the sense of non-sexual spore is hardly warranted. The word has a technical meaning in lichens, and its use in other orders has been superseded by better terms; and it is certainly undesirable to speak of the gonidia of Penicillium, for instance.

The work is likely to have a large sale among amateurs who wish a hasty glance at the subject; but it would be better for students to purchase some of the text-books, like Sachs or Luerssen, where they will find the same figures, and a full text as well.

ECONOMIC ENTOMOLOGY.

Injurious insects of the orchard, vineyard, etc. Illustrated with over seven hundred and fifty woodcuts and twenty-five pages of classified illustrations. By MATTHEW COOKE. Sacramento, *Crocker*, 1883. 472 p., illustr. 8°.

DURING the last few years, there has been a great growth in the popular appreciation of the importance of economic entomology. As a result of this growth, the demand for popular works on this subject has increased. To supply this demand, numerous publications have appeared in rapid succession. Of especial interest among these publications are the manuals of Miss Ormerod, Mrs. Treat, Mr. Saunders, and Mr. Cooke.

The work of the last-named author resembles in many respects the works of the others. Like them, it is largely a compilation; its chief merit being that it gives, in an easily accessible form, descriptions and figures which were scattered through many works. There is, however, some original matter. This consists of notes respecting various Californian species, which were studied by the author while serving in the capacity of chief executive horticultural officer of that state. The insects are discussed under the head of the plants they infest. The descriptions are written in a clear and popular style; but in some cases they are too brief, and in others they bear the marks of hasty compilation. A peculiar and excellent feature of the work is the bringing-together into one part descriptions of all the remedies suggested. These are referred to throughout the work by numbers. In this way unnecessary repetition is avoided. In the introduction a history of the legislation to prevent the spread of injurious insects in California is given. The work is profusely illustrated; but the good figures are not new, the new ones are not good, and all are poorly, printed. Still the book will be found to be a very useful one, especially to the fruit-growers of California.

Twelfth report of the state entomologist on the noxious and beneficial insects of the state of Illinois. First annual report of S. A. Forbes, for the year 1882. Springfield, Ill., 1883. 10+154 p., illustr. 8°.

IN this work we have the results of the first half-year of Professor Forbes's administration as state entomologist. In studying the report we are deeply impressed, both by the amount that has been accomplished and by the thoroughness with which the work is being done. Several of the articles in the report have been published separately during the past year, and have been noticed already in these columns. Of the other articles, the notes of experiments in the destruction of the European cabbage-worm, the account of a new plant-louse infesting cucurbitaceous plants, and studies on the chinch-bug, are the most important. The observations on Micrococcus insectorum Burrill, a bacterium parasite of the chinch-bug, are especially interesting.

We are glad to see that Professor Forbes has adopted the plan of intrusting some of the more special investigations to his assistants, and publishing the results they have

obtained in their own words, over their own signatures. One can hardly over-estimate the value of the added enthusiasm which assistants will bring to their work under this method. Not only will they do more work, but it will be of a much higher quality; and the office in which they are engaged will be able at an early day to command the services of a corps of specialists instead of mere day-laborers. At the same time a large part of the work of each individual in an office of this kind must be merged into what shall go out as the work of the office. And it is not the assistants alone who suffer from this; for the chief must devote much attention to executive duties, which shorten greatly his time for study.

In this report there are two papers by Professor Forbes's assistants. The first is an important article on the gall-mites, by Mr. H. Garman. It deals with the general characteristics of structure and habits of the Phytopti, and includes descriptions of seven new species, and the cecidii of several species for which names are not proposed. Previous to this, but three species have been indicated by name in the United States. The second paper is by Mr. F. M. Webster, and is an excellent account of the angoumois grain-moth and its parasites. There is also an account by Prof. T. J. Burrill, of the habits of Agrilus granulatus, which he has found to be a destructive borer of the Lombardy poplar.

First annual report on the injurious and other insects of the state of New York. By J. A. LINTNER, state entomologist. Albany, 1882. Senate doc. No. 93. (Issued October, 1883.) 381 p., 84 cuts. 8°.

AFTER an interval of eleven years, we are again favored with a report of a state entomologist of New York. This first report by Mr. Lintner is a large one, and evidently represents a great amount of work. The first eighty pages are devoted to a history of American economic entomology, and a discussion of the more important insecticides now in use. Then follow accounts of thirty species of insects. Of especial interest among these are those of Polype laricis, Crambus vulgivagellus, and some species of Anthomyiidae. In an appendix there is a very complete account of the writings of Dr. Fitch.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Paleontology. — During the field-season of 1883, Prof. W. W. Fontaine was detailed to collect and study fossil plants in Virginia. Late in July he began an examination of the tertiary strata in the vicinity of Richmond. Throughout the remainder of the season his field-work was continued on the mesozoic and tertiary of eastern Virginia, after which he was occupied in the preparation of drawings of the specimens collected.

Prof. L. C. Johnson, who has been working in the South Atlantic district, principally in Alabama, has returned to Washington after a most successful season. He is now engaged in unpacking and arranging the large collections that he secured during the summer and autumn. Several barrelfuls of material from the Claiborne group in Alabama were obtained; and the sorting of the extremely interesting collection included in them has kept him busy since his return from the field.

Mr. J. B. Marcou (assistant to Dr. C. A. White, in charge of the department of mesozoic paleontology) reports that a collection of very interesting fossils has been sent to the National museum from Skonum Point, British Columbia, by Mr. James G. Swan of Port Townsend, W. T. These fossils are being examined by Mr. Marcou, who says some of them are new, and that others are evidently identical with specimens from the coal-bearing rocks of Queen Charlotte Island, described for the Canada geological survey by Dr. J. F. Whiteaves in his 'Mesozoic fossils of Queen Charlotte Island.' Mr. Marcou says that the collection presents quite an oolitic facies.

Miscellaneous. — Mr. F. M. Pearson, topographer, who has been working in eastern Tennessee, says that the waste of valuable timber in that region, which has only recently ceased, is almost inconceivable. The finest specimens of walnut and cherry timber are found, and are used by the inhabitants for fence-rails, fire-wood, and other wasteful purposes. Since the survey has been working in the country, it has been instrumental in working a change in this respect, and the people are beginning to appreciate the value of their timber resources. Another result is, that the mineral resources are becoming known, and investments both in timber and in mineral properties are now being made where but a short time ago they would have been considered unprofitable.

Dr. Thomas M. Chatard of Baltimore has been appointed assistant chemist on the survey, and will be in the laboratory at Washington with Prof. F. W. Clarke.

Educational rock suites. — The survey proposes to collect suites of about one hundred representative rocks, to be used in teaching the elements of lithology. Two hundred specimens of each kind of rock will be

gathered; and they will be obtained as nearly identical as practicable, according to a scale adopted by the survey. Eventually, therefore, two hundred suites, of about a hundred specimens each, will be made up. They are to be accompanied by descriptive text, and issued to colleges and other educational institutions. The work of collection will be divided among the members of the survey, and will be distributed through about two years' time.

Additions to collections. — During the season of 1883 two hundred boxes of specimens were sent in to the main office of the survey by the various field-parties. They included rocks, minerals, fossils, and mineral waters. This number by no means comprises all the collections made, as a large number have not as yet been forwarded to Washington.

In the Rocky Mountain district, in charge of Mr. S. F. Emmons, with headquarters at Denver, Col., twelve hundred specimens of rocks from the Silver Creek mining-district were collected, and series of the type-specimens of hypersthene-andesite of Buffalo Peaks were secured.

After the close of field-work in the Yellowstone National Park, Mr. Joseph P. Iddings was sent to the Eureka district in Nevada to make collections of rocks for the educational rock series. He obtained sufficient material for two hundred cabinet specimens of five characteristic rocks. Three of them illustrate types of igneous rocks from the Great Basin, and two belong to the sedimentary series. They will all be fully described in the 'Geology of the Eureka district.'

Harvard college herbarium.

Additions. — Of the 8,755 sheets incorporated during the year, over 5,000 (holding probably 7,000 specimens) were derived from the rich herbarium of the late George Curling Joad of Wimbledon, near London, from which at least 3,000 more are still to be selected. For this most valuable collection of the plants of Europe and adjacent parts of Africa and Asia, or rather for such portion of it as will be retained, the herbarium is indebted to Sir Joseph Hooker, director of the Royal gardens at Kew, to which establishment it was bequeathed, and by whom, after certain selections had been made from it for the Kew herbarium, it was generously made over to this herbarium for the supply of its needs, the residue to be passed on to the National museum at Washington. So rich and abundant this collection proves to be, — containing, as it does, the principal published *exsiccata*, and most of the critical or local species of Europe, in authentic and attractive specimens, — that, notwithstanding the ample appropriation on our part, the materials which pass from our hands will still well represent the principal part of the European flora. This collection is supplemented by the presentation (in continuation of former gifts) of several hundred plants of Algeria and Tunisia, on the part of Dr. Cosson of Paris, who is engaged upon a Flora of Algeria.

The demand which such foreign collections make upon the time of the curator, Mr. Sereno Watson, and the director, Dr. Asa Gray, although very considerable, is small in comparison with that which has to be devoted to the critical examination and naming of the multifarious collections, large or small, which are incessantly poured in from all parts of our own country. A response to these demands cannot be avoided, generally cannot be deferred, in justice to the collectors and donors, and without risk of diverting the streams, which, flowing in ever since its establishment, have enriched this herbarium, and rendered it adequate to its leading purpose. But they press so heavily and unceasingly upon the officers, that they greatly retard progress in the preparation of works undertaken, and which ought to be proceeded with.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Ottawa field-naturalists' club, Canada.

Feb. 14. — Mr. W. Hague Harrington presented a list of Coleoptera captured in the neighborhood of the city during the past six years, and read a brief paper introductory to it. The list was stated to contain 926 species; but, as a large number remain yet undetermined, the list, when published, will include about 1,050 species. Many species are recorded which were formerly unknown in Canada, and there are three or four beetles which are probably new species. Mention was made of a few of the rarer forms which had been captured, such as Chrysobothris pusilla, Phymatodes thoracicus, Fornax badius, F. Hornii, and Sarpedon scabrosus. Of the latter, two females had been taken, which were now in the respective collections of Drs. Horn and LeConte. The collection was stated to be poor in Carabidae, Dytiscidae, etc., and comparatively rich in Buprestidae, Elateridae, Cerambycidae, and other families which had been specially investigated as containing species destructive to vegetation. The Ottawa fauna was briefly compared with that of several other districts, and was shown to resemble most closely that of Lake Superior. —— Mr. J. B. Tyrrell read a paper on the 'Revision of the Suctoria,' giving an outline of the different opinions held by entomologists in regard to the fleas, and the results of his own microscopical researches. A brief mention was made of some of the species which occur upon Canadian animals, and of the fact that other species had been found, both on mammals and birds, which it had been as yet impossible to determine. ——After an interesting discussion, the report of the conchological branch was read by Mr. F. R. Latchford. One species, Patula asteriscus Morse, had been added to the list of shells, and additional specimens of several very rare species had been obtained. Of the new shells, several specimens

had been obtained by Mr. Harrington while sifting moss for small Coleoptera; and with it occurred a number of other species, including Hyalina milium Morse, Pseudohyalina exigua Stimpson, Vertigo milium Gould, and V. Gouldii Binney. Among many other interesting and valuable facts was reported the rapid increase, in and around the city, of Limax agrestis Linn. In 1882 a single individual of this species was found in a garden. During the past summer it was found in hundreds in this garden, and other gardeners complained of its destructive attacks. The advent in Ottawa of this voracious species of foreign origin (long known in cities along the Atlantic coast) is a fact of much economic as well as scientific interest. After the reading and discussion of this report, the members spent some time in examining the specimens exhibited by Messrs. Harrington, Tyrrell, and Latchford, in connection with the papers and report.

Torrey botanical club, New York.

Feb. 12. — Dr. Newberry gave an account, continued from a previous meeting, of the vegetation bordering the line of the Northern Pacific railroad. Many of the trees are undoubtedly specifically the same as eastern ones, although considered and described as distinct. They should probably be referred to varieties of the same species. All are, no doubt, descended from the same ancestors, although now altered by the difference in surrounding circumstances. Many of the smaller plants are identical, but generally the aspect of the vegetation is very distinct and striking. The Douglass spruce (Abies Douglassii, Lindl.) and Pinus Lambertiana, Doug., are scarcely less in size than the famous 'big trees' of California. Some of the former are three hundred feet high and six feet in diameter. The annual rings are sometimes half an inch wide, showing very rapid growth. One specimen, about five feet in diameter, showed five hundred annual rings. Mountain mahogany (Cercocarpus ledifolius, Nutt.) has a very hard, dense wood, considered superior to coal for making a bright, hot fire. Several species of the genus Berberis are conspicuous features, owing to the showy racemes of berries. They are called indiscriminately 'Oregon grape.' Several species have apparently not been described. The 'Manzanita,' a name given to several species of Arctostaphylos, produces a fruit resembling a small apple, which is used as a food by the Indians. No hickory-trees are found, and only one hazel (Corylus rostrata, Ait.). The berries of Gaultheria Shallon, Pursh., are much used by the natives, as are also the fruit of the 'service-berry' (Amelanchier alnifolia, Nutt.) and several species of Vaccinium. Spirea millefolium, Torr., is very abundant and conspicuous: it would make a very ornamental garden-shrub. Artemisia tridentata, Pursh., is the common sage-brush of the region. Kalmia glauca grows the same as with us; and Rhododendron Californicum, Hook., is hardly different from our R. maximum, L.

Amongst the herbaceous plants are to be seen, particularly, three species of Mimulus, — cardinalis, Lewisii, and luteus. Antennaria dioica is very conspicuous with its red flowers. Many species of the genus Phlox are abundant and conspicuous. The showy genus Castilleia is also well represented. One of the most extensively represented genera is Eriogonum, — more than twenty species in this region. Many species of Ribes are to be seen, some of which have apparently not been described. Fire has devastated immense tracts of forest, and completely altered the appearance of the landscape in many places. Where the ground has been burnt over, there generally springs up a thick growth of Pteris and Vaccinium.

Peucedanum ambiguum, Nutt., is an important food-staple, the root being dried and powdered.

Cincinnati society of natural history.

Feb. 5. — Mr. W. H. Knight read a paper on the motions of fixed stars and on non-luminous bodies of space. —— Dr. W. A. Dun exhibited a series of relics from the Swiss lake dwellings, and read a short paper describing them. —— Prof. Joseph F. James gave a brief account of some observations on the common Caladium. After cutting off a growing, healthy leaf, a jet of water shot out from the apex of the unfolding leaf, and continued flowing with a rhythmical movement at the rate of a hundred and eighty pulsations per minute for several hours.

Academy of natural sciences, Philadelphia.

Jan. 10. — Miss S. G. Foulke stated that the modes of reproduction of Clathrulina elegans are four in number, — by self-division, by the instantaneous throwing-off of a small mass of sarcode, by the formation and liberation of minute germs, and by the transformation of the body into flagellate monads. The fourth mode is significant in bringing to light a new phase in the life-history of the Heliozoa. The Clathrulina, in which the phenomena were observed, withdrew its rays, and divided into four parts, as in the ordinary method; but the sarcode instantly became granular and of a rough surface. Then followed a period of quiescence, in this case of five or six hours' duration, although in other instances lasting three days and nights; after which one of the four parts began slowly to emerge from the capsule, a second following a few moments later. While passing through the capsule, these masses of sarcode seemed to be of a thicker consistence than the similar bodies, which, in the ordinary method, instantly assume the Actinophrys form. After both had passed completely through, for nearly a minute they lay quiet, gradually elongating meanwhile. Then a tremor became visible at one end, and a short prolongation of the sarcode appeared waving to and fro. This elongated at the same time into a flagellum, the vibrations becoming more rapid, until, at the same moment, both the liberated monads started away through the water. They were followed for about ten minutes, when both were lost to sight among a mass of sediment, and the fear of mistaking one of the common monads for them led the observer to abandon the search. Another monad was followed through various movements, and finally seen to attach the tip of its flagellum to the glass, and revolve swiftly for a few moments, when

instantly the whole body became spherical, rays were shot out, and the transformed monad was in no point, except that of size, to be distinguished from its Actinophrys-like relative. The whole development, from the time when the monad began its free life, occupied two hours and some seconds.

Prof. H. C. Lewis called attention to a mass of cast-iron from the Emaus iron-works, near Allentown. The iron contained crystals of graphite, which, again, held portions of cast-iron in their interior. The composition of cast-iron, which permits the formation of graphitic carbon, was considered, and compared with that of steel. Although the mass of iron must have been at one time in a molten state, it yet contained pieces of unaltered anthracite coal, which undoubtedly remained unconsumed in consequence of the entire absence of the oxygen necessary for its combustion. The presence of such unconsumed pieces of coal in a mass of molten iron might be held as illustrating the way in which carbon may exist in meteorites, or chalcopyrite in trap rocks.

Dr. Benjamin Sharp, referring to his recent communication on the visual organs of Solen ensis, stated that he had since determined the presence of similar organs in the mantles of the clam, the oyster, and the sand-clam. Their presence was made evident by the retraction of the mantles when shadows are passed over them. The structure of the peculiar cells, supposed to be primitive eyes, was the same as that of the cells before described in the siphon of Solen, including the presence of the transparent portion at the end of each.

Chicago academy of sciences.

Jan. 14. — The committee, consisting of Dr. H. A. Johnson and B. W. Thomas, appointed to investigate the bowlder-clays underlying the city, made its report upon a disk-shaped organism found both in the clays, and also in the filtrate from the water-supply, of Chicago. They were yellow, apparently flat or concavo-convex, and varied in size from $\frac{1}{85}$ to $\frac{1}{250}$ of an inch. Similar organisms have been found by several naturalists in the Devonian rocks of North and South America; and they were described by Dr. Dawson under the name of 'Sporangites,' and considered by him as macrospores of some acrogenous plant. Professor Orton of Ohio believes there are several species of varying sizes. We have, however, say the committee, none so large as discovered by Professor Orton. Our largest forms are not more than $\frac{1}{85}$ of an inch in diameter, and our smallest about $\frac{1}{250}$ of an inch. We have two, and possibly more, varieties. One has a well-marked ledge or zone around it, and extending, perhaps, an eighth of the way across it. Within this are the spines noted below. Others have no such markings, and do not, as a rule, have spines; and while some are a very light yellow, and almost transparent, others are of a dark reddish brown, and almost opaque. Whether these differences are sufficient to justify a separation of them into different species seems to be at present doubtful. So far, no forms have been met with by either of us, having any thing like a stem or point of attachment. Nor have we found any of the spherical or oval sacs which were contained in the collections of Mr. Derby, in Brazil.

There are found here, however, what we believe have not been found elsewhere; namely, on many of the disks, well-marked spines. These are, as a rule, clustered together, occupying a central portion, the diameter of which is three-fourths of the entire breadth of the disk, but in some instances the spines cover the entire surface. Along with these disks are, in quite large quantities, broken pieces of what seem to have been leaves, perhaps pinnate in form. Besides these, dark globular masses, which seem to be possibly spores or microspores, are frequently seen on the disks, and also scattered among them. These are — at least, in some cases — also contained within the substance of the disk. They are regular in form, and vary in size from $\frac{1}{600}$ to $\frac{1}{3000}$ of an inch in diameter. They are evidently organized; for in some cases there is seen a reticulum, or net-work, within the dark substance of the body. With these microspores, if such they are, are also masses of dark matter that, at least in some cases, are made up either of these globular forms alone, or of these and other organic material, such as the stems described by both Professor Dawson and Professor Orton. The clay beneath the city of Chicago and in the vicinity is full of bowlders of various sizes, from that of a walnut up to several cubic yards; and on many of these bowlders are well-defined ice-markings. Some of the smaller bowlders are shale which has never been ground down, and in these unchanged pieces we also frequently find large numbers of disks. These masses of shale, so far as we can ascertain, are identical with the shales of the upper Devonian formation. It will be seen that the disks are evidently not the product of their present location. They have been in some far-off age embedded in the shales; and subsequently these shales have been ground to clay, and, with other material constituting the bowlder-clays, have been redeposited beneath the lake and the adjacent shores. They are now undergoing another dispersion; for they are washed from their present position in the Chicago clays, and are mixed with the sands and alluvium, to be carried by the currents and winds to some new resting-place. Consequently our water-supply is now full of these products of probably some millions of years ago. They were perhaps water-cresses, and might have been of excellent flavor when fresh. They were fragant with gums or spices, as we know from their present composition. They are not now probably injurious to health, but they are especially valuable as a reminder, that in some widely different time, and amid very different surroundings, an abundant marine vegetation was being produced which has been preserved to our own day.

Vassar brothers' institute, Poughkeepsie, N.Y.

Jan. 2. — C. B. Warring, Ph.D., exhibited the gyroscope, and gave the explanation of its action the following form.

Dr. Warring, in giving his explanation of these phenomena, said it was important to clearly grasp these two principles: 1. A body set in motion will con

tinue in motion until something stops it; 2. A body moving in any direction is not retarded by a force exerted at right angles to its direction.

We will suppose the ring to be laid aside, since it serves only for holding the disk, and that the disk or wheel is cut away until only a narrow strip is left, like two arms extending in opposite directions from the axle: its form will then resemble a T-square, which will now be used to illustrate the actions of the gyroscope.

Hold the stem of the square in the left hand, close to the end, and make the cross-piece vertical; hold the left hand still, and let the cross-piece move up or down: evidently it will describe part of a circle. If it is held so that the cross is just in front of a plumb-line, so that both can be viewed at once, it will be seen that the upper end of the cross moves away from the plumb to the right, while the lower moves away from it also, but to the left. If, while the left hand remained stationary, the cross had been allowed to drop freely, the top and bottom would evidently acquire a certain horizontal motion, one to the right, the other to the left. If, now, the T-square be quickly turned over, so that the top and bottom change places, this will not interfere with motion previously acquired: the bottom (which has now become the top) will continue to move to the left, while that which was the top will move to the right; and, as the motion continues (as in case of a pendulum), the ends of the cross are pushed back to where they were, and the instrument rises to its first position.

This explains why the gyroscope, in apparent defiance of the law of gravity, remains, when supported only at one end, in a horizontal position.

To understand why the instrument rotates around the central point, in a direction always the opposite of that of the top of the disk, the T-square is again brought into service. Hold it as before, and let it fall a few inches: as in the first experiment, the top, when the T goes down, gets a motion towards the right; but, before the instrument can be reversed, it must go half way, and point horizontally, instead of up and down. Evidently the motion which sends the upper end to the right will push the instrument (if the top was revolved towards the south) towards the north: hence the horizontal motion.

The horizontal motion is slow in proportion as that of the disk is rapid, because of the movement of the arms of the T. If the T turns slowly, it has more time to give motion to the ends of the arms, and consequently they push it around faster. If the T turns very quickly, it falls a very short distance (has so little time): hence the ends of the arms get very little motion, and, of course, can impart but little. A quick motion of the disk, therefore, makes a slow horizontal movement, and a slow motion of the disk makes a quick horizontal movement.

A careful consideration of the above will make it easy to see why the gyroscope ceases to maintain itself if the lateral (or horizontal) motion is stopped; for, in order to maintain itself, the motion imparted to the ends of the T-square, when vertical, must be expended in lifting: if spent in any other way, nothing is left to overcome gravity. Now if, as the square falls, and the T has become horizontal, some obstacle prevent its moving still farther to the right, its motion in this direction would cease; and, of course, when it arrived at the lowest point, nothing would be left to lift the instrument.

Another paradox is, that the instrument must fall somewhat, in order to produce any of its peculiar phenomena; but this, too, is easily explained. Every thing depends upon the two extremities of the T getting a motion, one to the right and the other to the left, when the T is vertical. If the T does not fall, or if it is not lifted up (for either movement will do equally well), there will be no such motion: only, if the first sends the instrument north, the other will send it south.

This directly or impliedly explains all the phenomena of the gyroscope.

NOTES AND NEWS.

THE death of Guyot has been soon followed by that of another of the notable scientific men, who, educated in Europe, took up their lot with us, and became, so to say, wholly our own. Dr. George Engelmann of St. Louis — our oldest botanist (excepting the venerable Lesquereux), as well as an eminent physician, for a time a fellow-student with Agassiz in Germany — died on the 11th inst., at the age of seventy-five. A biographical notice may be expected in an ensuing number.

— The *Journal of agricultural science* proposed from the North Carolina agricultural station recently, and to which we referred Dec. 28, has met with universal approval and most unexpected support.

Nearly one hundred shares of stock have been taken upon the plan proposed; and the Houghton farm proposes to assume all of the mechanical work of a monthly journal, and guarantee this part of its expense for one year. Without any special effort to secure them, about three hundred subscribers are reported.

In response to a cordial invitation of the commissioner of agriculture, a meeting will be held to organize this enterprise, at the Department of agriculture at Washington, at ten A.M., Wednesday, Feb. 27. All the friends of the scheme are urged to be present at this meeting, and participate in the inauguration of the journal. It is hoped that each agricultural college, experiment-station, etc., will send a representative.

— Commodore Samuel R. Franklin, U.S.N., has been detached from duty on the naval examining board, and ordered as superintendent of the naval observatory, to succeed Rear-Admiral R. W. Shufeldt, who was placed upon the retired list on Feb. 21.

— At a concert given by the Choral club of the University of Wisconsin on the evening of Feb. 8, two songs by Sir William Herschel were sung, — the first, a glee, 'Go, gentle breezes;' the second, a catch,

'They say there is an echo here.' The manuscript copies of this music were loaned by the college library.

— The American ornithologists' union, with the enthusiasm of new institutions, has taken up the English sparrow question in an energetic and scientific way. A committee of the association has issued a circular asking answers to a series of twenty-eight questions. The value of the replies, especially to the later questions, will vary exceedingly; and we should judge it exceedingly difficult to assign them their proper relative value. Nevertheless, the general conclusion the committee will reach as to whether the bird is, on the whole, injurious or beneficial to agriculture, will not be likely to be disputed. The committee has divided the field among its members, Mr. Montague Chamberlain of St. John taking the British provinces; Mr. N. C. Brown of Portland, the three northern New-England states; Mr. H. A. Purdie, the other New-England states; Mr. E. P. Bicknell of New York, New York and the Western states; and the chairman, Dr. J. B. Holder of New York, the Southern and Middle states. The committee intends to construct a map of the present geographical distribution of the sparrow; and any volunteer information by those not reached by the circular will be gladly received by the chairman, who may be addressed at the American museum of natural history, New York. The authorities in Bermuda already offer bounties for the destruction of the sparrow, although heavy penalties are laid on the destruction of other birds on that lonely island.

— The sixth Saturday lecture of the Washington course was delivered on Feb. 9, in the lecture-room of the National museum, by Capt. C. E. Dutton, U. S. A., on 'The Hawaiian Islands and people.' Capt. Dutton visited the islands two years ago, in the interest of the Geological survey, to study the volcanic phenomena there for purposes of comparison with the region of extinct volcanoes in the western part of our own continent. His lecture was devoted in large part to a discussion of the geology of the Hawaiian group. An audience of about eight hundred was present. Mr. H. C. Burchard, director of the Mint, occupied the chair; and at the close a vote of thanks was moved by Major J. W. Powell.

— The Fish-commission steamer Albatross, now cruising in the Caribbean in behalf of the Hydrographic office, arrived at St. Thomas, Jan. 17, after a seven-days' voyage from Norfolk, and, after coaling, started on the 24th for Curaçoa, where she was due on the 14th of February. While at St. Thomas, the naturalists of the ship made considerable collections of birds and shallow-water invertebrates.

— Mr. F. W. True, curator of mammals in the National museum, is now at the British museum, studying the types of cetaceans, and especially of the Delphinidae, with the view of settling some important questions in the nomenclature and relations of the North-American forms. It is probable that his studies will demonstrate the identity of many of our Atlantic species, described as distinct by Agassiz, Cope, and others, with long-known European forms.

— At the November meeting of the Society of biblical archaeology, London, Mr. Budge of the British museum read a paper on the fourth tablet of the series of cuneiform texts relating to creation. Mr. Rassam has recently found a large Babylonian fragment of this fourth tablet. The language of the tablet is vigorous, and, like that of many of the cuneiform hymns, approaches in dignity the majestic roll of the Hebrew psalms. The deepest interest in connection with the tablet is the apparent acquaintance with rhyme and rhythm. Mr. Budge does not give enough of the original to aid us in testing this subject, but what he does give is favorable to the supposition. A peculiar kind of alliteration in the Babylonian cuneiform writing is already familiar. The fragment of a hymn on pp. 15 and 16 of Mr. T. G. Pinches' 'Texts in the Babylonian wedge-writing' is divided into stanzas of five lines each, and the same syllable begins each line of the stanza. There are five lines beginning with *ar*, five with *ba*, five with *su*, etc.

— The London papers are now discussing the desirability of opening the various museums of that city in the evening, for the benefit of that large class who have no command of their time during the day. The *Globe* is filled with letters on the subject. This discussion is called forth by the rumor that a bill will be presented in Parliament at the next term, for the opening of several of the more important art-galleries, museums, etc., after business-hours. South Kensington museum, and the Museum of practical geology, are now open from ten A.M. to ten P.M. on Saturdays, Mondays, and Tuesdays. There is no doubt but that these evening sessions are very useful, especially to that great and intelligent class of persons who do not belong to the group of 'workingmen' as that word is generally understood, but who, nevertheless, earn their living by work during the day, and have only the evening in which to gain information and widen their mental horizon. Many of our own cities would be greatly benefited if the museums and art-gallery could be opened in the evening.

— It has been the feeling for some time past in Germany, that that country should have a meteorological society. The want of this has been met by the publications of the Austrian society; but now that meteorology is making such rapid strides, and so many are becoming interested in it, there is much reason for the recent move made by the German meteorologists.

On Nov. 18, 1883, the following well-known contributors to our knowledge of this science met at Hamburg to ground a 'Deutsche meteorologische gesellschaft:' Assman, van Bebber, vo nBezold, Börgen, Börnstein, von Danckelman, Dinklage, Ebermayer, Hellmann, Honsell, Karsten, Klein, Koch, Köppen, Krebs, Müttrich, Neumayer, von Schroder, Schreiber, Sprung, Thilenius, Zöppritz. Many others sent letters expressing their intention to give aid to the project. The first general meeting of the society

will take place in September, 1884, at Magdeburg. Dr. Neumayer is president.

The aim of the society is to pay attention to the science of meteorology, as well as its relations to practical life. As a means of accomplishing this, 1°, meetings of the society and its branches will be established; 2°, a journal of meteorology will be issued; 3°, meteorological investigations will be aided, partly directly, and partly through its branches; 4°, lectures and other measures will be introduced for the distribution of meteorological knowledge in wider circles. The members are to be honorary, foundation, ordinary, and corresponding. The yearly assessment for ordinary members is ten marks ($2.50).

From private letters we are informed that the first number of the journal will be issued in a couple of months. It might seem at first as though this new journal would interfere with the work of that excellent journal, the *Oesterreichische zeitschrift für meteorologie*; but we believe that the editors of the journals will enter into such relations with each other that the two journals shall be supplementary the one to the other. It may be expected that this new journal will occupy as important a place as the Austrian, and therefore it ought to find its way into the hands of all those who wish to keep informed of the progress of this science. The *Deutsche seewarte* at Hamburg will naturally be the chief seat of work in connection with the issue of this journal. The treasurer of the society is Mr. Ernst Bopp, Königstrasse, No. 6 II, Hamburg.

— The M. P. club, a club of mathematicians and physicists living in Boston and vicinity, which meets once a month for the discussion of vexed questions in their departments, has issued the following list of subjects for discussion: —

1. Given a solid body in which the moments of inertia about four axes passing through one point are equal, does it follow that the moments of inertia about all axes, through the same point, are the same? 2. Are there any general methods for determining the form of a function when certain special values are known, or when certain conditions are given? For example: (*a*) To find $F(x, y, z)$, given $F(x, x, z) = 0$, and $F(x, y, z) = 1$. One solution is $F(x, y, z) = \frac{x-y}{z-y}$: what others are there? (*b*) $p = F\left(\frac{u}{v}, \frac{du}{dv}\right)$, $t = \dot{F}\left(\frac{u}{v}, \frac{du}{dv}\right)$: given $\frac{dp}{dv} + \frac{p-t}{v} = 0$, also given, that, when $\frac{u}{v}$ and $\frac{du}{dv}$ are interchanged, then p and t are interchanged, to find F and $\dot{F}$. 3. "Is it, therefore, an essential condition of equilibrium that $p\,(X\,dx + Y\,dy + Z\,dz)$ should be a perfect differential of some function?" (W. H. Besant's 'Hydromechanics,' p. 13.) "In this case of compressibility, $u\,dy - v\,dx$ is not the differential of any function; so that the function F does not exist, although, of course, stream lines exist" (Minchin's 'Kinematics,' p. 152). Such passages as these suggest the inquiry, "How are we to interpret physically the fact that a given differential is not an exact differential?" (see Clausius' 'Mechanische wärmetheorie,' p. 4.) 4. The graphical treatment of algebraic problems (see Vose's little book on the subject, published by Van Nostrand). 5. Graphical statics. 6. Anharmonic ratios; suggestions of new nomenclature. 7. Koenig's researches on beats and beat tones. 8. Euclid's doctrine of proportion. 9. Multiple algebra. 10. The comparison of Grassmann's theory of extension and Hamilton's quaternions. 11. Imaginaries in quaternions. 12. Weierstrasse's investigations in analytics and geometry. 13. The precise nature of the ancient problem of the quadrature of the circle. 14. The twelfth axiom of Euclid. 15. The bearing of the modern conception of non-Euclidean space on our theory of the foundation and certainty of geometric truth. 16. The true relation of hyper-space analytics to questions of actual existence. 17. Riemann's surfaces. 18. The meaning of an infinitely distant point on a straight line. 19. $\frac{1}{\infty}$ does not equal $a - a$. 20. Cayley's exposition of the logical structure of plane geometry ('Encycl. Brit.,' 9th ed.). 21. The synthetical (as opposed to analytical) character of all judgment and proof that is strictly mathematical. 22. The development of algebra from first principles as the science of pure time. 23. The calculus of logic. 24. The writings of François Viète. 25. Comparative merits of the method of limits and method of infinitesimals in elementary methods. 26. The same in the exposition of the higher calculus (with especial reference to Johnson and Rice's new 'Method of rates'). 27. Is gravitation a truth empirical, or *a priori?* and the limits of Newton's law of rate in gravity. 28. The principle of least resistance. 29. What exactly is meant by the correlation of forces, and what is its bearing on the conservation of energy? 30. The dissipation of energy. Its meaning and bearing on the stability of the universe. 31. Recent researches upon the atomic theory and upon the resolvability of the elements. 32. What constitutes the chief resistance in the case of a body moving through the water? 33. What is the form of least resistance for a row-boat? What for a sail-boat? What for a steamer? 34. Cause of capillary ascensions and depressions. 35. The means whereby water is able to penetrate capillary tubes against a superior pressure of a gas (see Daubrée's 'Études synthétiques de géologie expérimental,' Paris, 1879). 36. Microscopic action. 37. The diathermancy of ice from the point of view of James Croll's theory of glacial motion. 38. Direction of electric currents in diamagnetic bodies, e.g., bismuth. 39. Underground telephone circuits. 40. Elasticity and permanent set. 41. Diffraction gratings, plane and curved. 42. A short discussion (not too technical) on some of the instruments of research, such as the bolometer and the inductive balance. 43. Recent researches on the distance of the sun. 44. The origin of meteorites: are they volcanic ejections? 45. The aurora borealis, zodiacal light, etc. 46. If steam be enclosed in a cylinder open on the outside to the air, and compressed, is it possible to get a compression curve concave downwards (abscissae representing volumes, and ordinates pressures), and, if so, when?

SCIENCE.

FRIDAY, FEBRUARY 29, 1884.

COMMENT AND CRITICISM.

SOMETHING was said in these columns recently about the shortcomings of geography-teaching in the lower schools. The same complaints hold in regard to elementary science teaching in general. The wave of enthusiasm for teaching science in primary and middle schools, which swept the country a few years ago, has not brought us as much nearer the millennium as was at first fondly anticipated; but it has left many of us wiser, if not sadder. There was at first a general but strange misconception of what ought to be taught, and how the teaching was to be done. A poor workman with bad tools, which he does not know how to use, is hardly likely to turn out a finished product. One distinguishes genuine metal by its ring, only after he has heard it many times; and a teacher who knows little or nothing of any department of science is easily caught by the tone of a text-book which is often little better than a base alloy. 'Science made easy' finds its way into the schoolroom to the temporary delight of both teacher and pupil, but to the lasting benefit of neither.

Have the scientific men of this country done their full duty in this matter? It is a pertinent question, and it cannot be answered in the affirmative. Two forces are here to be dealt with, — the teachers and the text-books. Concerning the latter, it will be remembered by many that something akin to a sensation was produced, at the Minneapolis meeting of the American association for the advancement of science, by Professor Rowland's vigorous denunciation of American science text-books. His resolution was doubtless too sweeping in its character, — more so, in fact, than was really intended by its author; but it cannot be denied that it contained a large measure of wholesome truth, however unpalatable it might have been. But can Professor Rowland and others, whose names will occur to the reader, hold themselves wholly free from responsibility in the premises? It is not unreasonable to assert that the preparation of text-books, including those that are elementary in their character, ought to be undertaken by specialists; and it is gratifying to know that many eminent American scholars have not shrunk from their duty in this respect. A few years ago, in a review of an elementary treatise on physics, Clerk Maxwell remarked that there seems to be "some opposition between accurate statements and school-teaching, which, if not a fundamental necessity, is at least a universally existing phenomenon in the present order of things." Nowhere is the hand of a master more needed than in the making of an elementary text-book. Science can be 'made easy' by being made clear and accurate; and such elementary treatises as those prepared by Maxwell and Balfour Stewart show how well the real scholar can do this. It can hardly be done by any one else.

THE recent deliberations of the committees of the American ornithologists' union, upon the rules of zoölogical nomenclature, will, when published, be of great interest to zoölogists working in other classes. The day is not far distant when the nomenclature of American zoölogy, particularly in its vertebrate division, will be reduced to a uniformity based upon consistent interpretation of the law of priority. American zoölogists are now waiting with much curiosity to see what their fellow-workers in Europe are going to do in the matter, and whether it be possible that they will cling to the illogical and inconsistent usages now prevalent among them. At present the names sanctioned by the great authorities, like Cuvier, appear to be regarded as sacred and immutable. In a recent official report upon the

Berlin fishery exhibition, Professor Giglioli, the leading authority in Italian vertebrate zoölogy, commenting upon the collections sent from the U. S. national museum, remarks, "I feel obliged to make reference to the singular nomenclature current among the zoölogists of the United States, which is in most instances entirely arbitrary, and at variance with that generally adopted in Europe. Only the working zoölogist can form an idea of the confusion which is sure to result from such practices. If the present courses are continued, they will end in the destruction of the wise, convenient, and simple *sistema zoologico* conceived by the great Linnaeus."

Most English zoölogists follow, though not very consistently, the rulings of the Stricklandian code; but on the continent, except in Norway, there appears to be no general appreciation of the importance of conforming to any consistent policy in nomenclature. The authority of Cuvier, or one of his contemporaries, is allowed to outweigh any consideration of justice or uniformity. In the United States, however, the number of indigenous species to be systematically catalogued is so great, that systematic zoölogists have been forced to follow the rule of priority, without fear of contemporaries, or favor to the workers of the past. It is somewhat unfortunate that the common sea-bream of Europe should be known to transatlantic ichthyologists as Sargus vulgaris, while here it is called Diplodus sargus; equally so, that our black bass, Micropterus salmoides, should there be known as Huro nigricans. The American zoölogist has, however, the advantage of standing on a foundation of priority, upon which his European brethren must sooner or later take refuge, or be overwhelmed in an ocean of synonymes.

IN closing a review of the different means employed by man to rid himself of destructive insects, Mr. de Fontvielle expresses a regret that the attempts made to popularize the use of insects as food have made so little progress. We are, in fact, behind the Chinese, and even behind the monkeys, who, if we may believe Millet, eat their own lice. It is not necessary, he adds, to go to this length; but we ought not to forget the remark of the Roman emperor, who said that the body of an enemy never tasted bad, and the banquet of the Society of insectology, before which he spoke, would always lack something so long as there was not placed before them at least some grasshopper farina and fried white worms.

'CHARACTERIZED by high, unbroken mediocrity' is the description which the *Pall-mall gazette* gives of the literature of the past year. This only brings up again the question whether the age of literature and of good talkers, as well as writers, may not be passing away. The energies of a large portion of the able men of the present are occupied by the work of their special avocations, — avocations in which they have few associates, or possibly none, in their particular branch. What has the foremost position in these men's thoughts they find no opportunity of mentioning to those with whom they may be thrown. Where Franklin found time to be a printer, a statesman, and a physicist, is now so much ground to be covered, that a physicist may soon be a thing of the past; the electrician possibly being quite ignorant of the laws of heat, and each student only striving to cover faithfully the subject of sound, or light, or heat, as may seem most attractive. Shall the active man of the future limit himself in his department that he may gain a polish that will make him the more agreeable companion? or, that he may serve the world's purpose the better, shall he, by his education, largely separate himself from all others? What this differentiation has come to, is shown by the fact that a learned academy not long ago honored with a gold medal a memoir which no member had read. A meeting of this society has often been compared to a funeral, — a funeral only to be enlivened by the queries of some garrulous layman; and how can it be otherwise when the words of our wiseacre fall upon the ears of others, incapable of vibrating in sympathy?

LETTERS TO THE EDITOR.

A clock for sending out electric signals once an hour or oftener.

It is necessary that the central clock of a system of controlled clocks should send out an electric signal once an hour, by means of which signal the controlled clocks have their hands set to time.

It is often convenient to have such a clock send out signals oftener than once an hour: for example, at the University of Wisconsin a central clock automatically rings an electric bell in each recitation-room at the end of each hour, and also at ten minutes before the end of the hour, i.e., at fifty minutes and sixty minutes.

There are many ways of accomplishing this end. One of the simplest of these is described below from a clock which is now in use at the Washburn observatory to control by hourly signals a system of secondary clocks in the city of Madison.

The apparatus was made in the University machine-shops by me, and cost, perhaps, five dollars; and it is perfectly satisfactory in its operation. Figs. 1 and 2 represent the projection and section of an ordinary clock-dial, with a ring of black walnut or ebony, *B*, screwed on it.

Around the outer circumference of *B*, and about a quarter of an inch from it, runs the brass wire *C*. This wire is threaded from end to end, and, passing through the four screw-eyes *k*, *k*, is held to, and supported by, the wood ring *B*. The two ends of the wire are joined by means of a long nut, or thimble, *b*. Strung loosely on the threaded ring *C*, and at various points of its circumference, are the small brass nuts *a*, *e*. Some of these are employed as jam-nuts, *a*, *a*, to prevent any tangential motion in the threaded ring. The walnut ring can be made of convenient thickness, so that the minute-hand will pass over it; and for final adjustment the minute-hand may be bent in or out to get the required contact pressure. A thin strip of platinum (*P′*, fig. 3) is soldered to the under side of the minute-hand along the portion which traverses the walnut ring *B*. Around this *point* is fitted the small block, *I*, of bone or vulcanite, with its under face sloping upward to form a sort of inclined plane to precede the platinum point *P′*. A short piece of platinum wire of suitable size is flattened at one end (*P*, fig. 3); and the flattened part, secured to the small piece of vulcanite, *s*, is laid upon the walnut ring *B*. The other end is bent round the threaded wire *C*, and secured in place by means of the nuts *e* strung on the ring for that purpose.

FIG. 1.

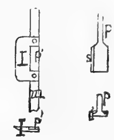


FIG. 3.

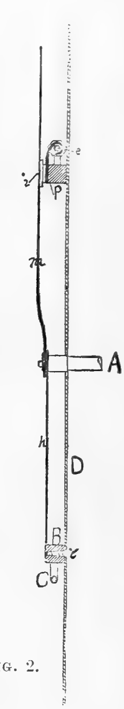


FIG. 2.

The points at which the circuit is made and broken are the platinum points *P*, *P′*. The minute-hand, being carried around with its point *P′* in light contact with the ring *B*, is sprung out when the inclined block *I* comes in contact with the projection of *s*; and, being carried along, the points *P*, *P′*, are brought together by the springing-back of the hand. The length of contact depends on the width of the point *P*, and may be varied at pleasure. The circuit-wires are led from the works of the clock and the threaded ring respectively, and may be provided with suitable binding-posts outside the clock. As the ring *C* runs clear around the dial, a platinum point may be inserted anywhere in its circumference; so that any number of signals may be made during the hour, or those already set may be easily changed. The nuts *e* on the threaded wire not only insure a good metallic contact with the platinum point, but aid materially in its adjustment for a given time of contact. The device is simple, in that it requires no great delicacy of workmanship in its construction, and is of such a form that almost any clock will receive it without change.

H. W. PENNOCK.

Deafness in white cats, and statistics of deafness and epilepsy in America.

In my letter of the 4th inst. (*Science*, iii. 171) I drew attention to the remarkable fact, that white cats, if they have blue eyes, are almost always deaf.

Darwin, in his book on 'Animals and plants under domestication,' attributes the peculiarity to a slight arrest of development in the nervous system in connection with the sense-organs. He thinks there is nothing unusual in the relation of blue eyes and white fur; but in regard to the deafness, he says (ii. 323), —

"Kittens, during the first nine days, whilst their eyes are closed, *appear to be completely deaf.* I have made a great clanging noise with a poker and shovel close to their heads, both when asleep and awake, without producing any effect. The trial must not be made by shouting close to their ears; for they are, even when asleep, extremely sensitive to a breath of air. Now, as long as the eyes continue closed, the iris is no doubt blue; for, in all kittens which I have seen, this color remains for some time after the eyelids open. Hence, if we suppose the development of the organs of sight and hearing to be arrested at the stage of the closed eyelids, the eyes would remain permanently blue, and the ears would be incapable of perceiving sound; and we should thus understand this curious case. As, however, the color of the fur is determined long before birth, and as the blueness of the eyes and the whiteness of the fur are obviously connected, we must believe that some primary cause acts at a much earlier period."

Darwin's conclusion is supported by a remarkable case recorded in France by Dr. Sichel (*Annales sc. nat., Zool.* 3d series, 1847, viii. 239), in which the iris, at the end of four months, began to grow dark-colored, and *then the cat first began to hear!*

In the human race, also, while it is exceedingly problematical how far congenital deafness is associated with a deficiency of coloring-matter in the skin and hair, it appears, according to Darwin ('Animals and plants under domestication,' ii. 322), that some relation exists between various affections of the eyes and ears.

He states that Liebrich found, upon examining the eyes of 241 deaf-mutes in Berlin, that no less than fourteen suffered from the rare disease called pigmentary retinitis. He also states, upon the authority of Mr. White Cooper and Dr. Earle, that color-blindness is often associated with a corresponding inability to distinguish musical sounds.[1]

I have already shown that the census returns for 1880 indicate that the proportion of deaf-mutes among our colored population is much less than among the whites; but private inquiry at the census bureau seems to show that the proportion of *congenitally* deaf among the colored deaf-mutes, instead of being less, is very much greater, than among the white deaf-mutes.

Of 19,475 white deaf-mutes, 10,738 (or 55 per cent) were stated to have been born deaf, and 8,737 (or 45 per cent) were returned as deaf from disease or accident: on the other hand, of 1,751 colored deaf-mutes, 1,301 (or no less than 74 per cent) were reported as congenitally deaf, and only 450 (or 26 per cent) as deaf from disease or from accidental causes.

By the kindness of Gen. Seaton, I am enabled to give the following unpublished figures from the census returns bearing upon the point: —

Number of deaf-mutes in the United States, living June 1, 1880, *arranged according to race and sex.*

Causes of deafness.	Colored.		Foreign white.		Native white.		Total.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Congenital . . .	714	587	545	444	5,229	4,520	6,488	5,551
Injury to ear . .	7	2	8	2	34	17	49	21
Disease of ear . .	7	8	10	7	204	166	221	181
Other diseases . .	178	147	306	252	4,172	3,368	4,656	3,767
Miscellaneous . .	73	28	81	77	610	423	764	528
Not stated . . .	..	..	..	..	..	..	6,389	5,263
Totals	979	772	950	782	9,249	8,494	18,567	15,311

[1] These statements are taken from Mr. Sedgwick, in the *Medico-chirurg. review*, July, 1861, p. 198; April, 1863, pp. 455 and 458. Liebrich is quoted by Professor Devay in his 'Mariages consanguins,' 1862, p. 116.

In my former communication I quoted from Dr. Lawson Tait's paper on 'Deafness in white cats' (*Nature*, xxix. 164) the following remarkable statement: "Every kind of white animal I have kept as a pet has proved to be the subject of epilepsy; and the association is suggestive, when we are told, as I have been frequently, that the disease is unknown among negroes."

I presume that Dr. Tait must have referred to the negro in his native habitat; for I find, upon inquiry at the census bureau, that epilepsy appears to be more common among the colored people of America than among the whites. I am indebted to the courtesy of Gen. Seaton for the following unpublished figures from the tenth census: —

Percentage of epileptics in the United States, 1880, *by race and sex.*

White male	.004749
White female	.003751
Black male	.005011
Black female	.004267
Indian male	.002942
Indian female	.003084
Chinese male	—
Chinese female	.020925

These results will doubtless be of interest to your readers. Alexander Graham Bell.

Washington, D.C., Feb. 29, 1884.

In a letter to *Science* of Feb. 15, Prof. A. G. Bell quotes from Dr. Lawson Tait, that "every kind of white animal I have kept as a pet has been the subject of epilepsy; and the association is suggestive when we are told, as I have been frequently, that the disease is unknown among *negroes.*" This remark in regard to the negroes, I know, cannot be entirely true. I am a southern-born man; and I have seen a great deal of negroes all my life, and have always considered that epilepsy prevailed among them, even to a greater extent than among white people. I can easily give a number of instances of its occurrence, coming under my own observation and that of my friends to whom I have mentioned the subject.

Georgetown, D.C., Feb. 21, 1884. Benj. Miller.

The Krakatoa eruption.

The council of the Royal society has appointed a committee for the purpose of collecting the various accounts of the volcanic eruption at Krakatoa, and attendant phenomena, in such form as shall best provide for their preservation, and promote their usefulness.

The committee invite the communication of authenticated facts respecting the fall of pumice and of dust, the position and extent of floating pumice, the date of exceptional quantities of pumice reaching various shores, observations of unusual disturbances of barometric pressure and of sea-level, the presence of sulphurous vapors, the distances at which the explosions were heard, and exceptional effects of light and color in the atmosphere. The committee will be glad to receive, also, copies of published papers, articles and letters, bearing upon the subject.

Correspondents are requested to be very particular in giving the date, exact time (stating whether Greenwich or local), and position whence all recorded facts were observed. The greatest practicable precision in all these respects is essential.

All communications are to be addressed to

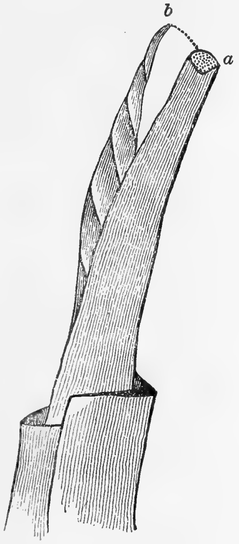
G. J. Symons,
Chairman Krakatoa committee.

Royal society, Burlington House,
London, Feb. 12, 1884.

Expulsion of water from a growing leaf.

My attention was some time ago called to an interesting and remarkable fact in connection with the expulsion of water from the tip of a growing leaf. It is well known that drops of water are often found on the margins and apices of growing leaves. It is readily observable in corn and other grasses (see Sachs's text-book, p. 676); but the phenomenon to which I wish now to call attention is of another character. The circumstances were as follows: —

A lady had growing in her house a strong and thrifty Caladium with three or four large leaves. A new leaf being ready to expand alongside of an old one, this last was cut off at *a* in the figure. It was noticed soon afterward, at about half-past ten A.M., that from the apex of the new leaf (*b*) there was being shot out, for a distance of about an inch, a jet of water, falling in the shape of very fine spray on the cut surface of the other leaf. The jets were counted, and it was found that there was a regular *pulsation of about a hundred and eighty per minute;* that is to say, three jets of water were forced from the apex of the leaf every second. It was observed from time to time until five P.M., and but little cessation of the rate of motion was seen. At eight the next morning the pulsations were about a hundred and twenty per minute; and they gradually decreased, until, on the third day, drops of water would accumulate at the apex, and be expelled with some force at a rate of about ninety per minute.



It is to this regular pulsating movement of the water that I wish to call attention. I cannot find, in any of the books accessible to me, any account of any such motion in the water of plants. Sachs does not mention it; and, if any of your readers know of the mention of any such motion, I should like to know where it is to be found. We know that the exudation of water from cut surfaces, or newly-expanding leaves, is often caused by the taking-away of an evaporating surface (say, a large leaf) while the root is still absorbing a large amount of moisture from the soil (see Sachs's text-book, p. 689); but why this pulsating movement? There can be no doubt as to the accuracy of the observation, as it was seen by several persons besides the owner of the plant. Prof. J. W. Lloyd of this city has informed me that some years ago he made the same observation, but he has not been able to give me an exact statement as to what took place.

JOSEPH F. JAMES.

Cinc. soc. nat. hist., Cincinnati, O.

[This interesting phenomenon has been described by Musset, who states that water was forced from the leaf-tips of Colocasia antiquorum, another plant of the Aroid family, with such force that the jet was three inches and three-quarters high (*Comptes rendus*, 1865, 683). Professor Pfeffer, to whom we are indebted for this reference, calls attention to a singular communication by Munting (1672), who describes the emission of a fine stream of water from the leaves of certain Aroideae, *resembling a fountain.*]

A scientific swindler.

A few weeks ago a man calling himself N. R. Taggart, and claiming to be a member of the Ohio geological survey, visited Philadelphia. He called on the principal scientific men of this city, and attended one of the regular meetings of the Academy of natural sciences. He seemed to have an extended acquaintance with scientific men all over the country, talked very glibly about fossils, and claimed to be preparing a report on the Productidae for the Ohio survey. He is about five feet eight inches in height, a hundred and sixty pounds in weight, heavy set, heavy featured, with light hair, and rather deep-set eyes, shabbily dressed, and wore an old gray overcoat. He had an adroit way of ingratiating himself into the confidence of his intended victims; and then, if he could not steal, he would, under some plausible pretext, borrow valuable books or specimens to take to his hotel, and forget to return them. His victims are to be found scattered all over the country. In New York he was E. D. Strong of Fort Scott, Kan., and claimed to be employed by the Kansas Pacific railway to collect statistics of coal production. In West Philadelphia he gave his address as E. Douglas, Columbus, O., member of the State survey. In Auburn, N.Y., he was a deaf-mute, under the name of E. D. Whitney, U. S. geologist, Denver, Col. There he obtained a large quantity of valuable books and fossils from the family of Professor Starr, in the absence of the owner. In Harrisburg, Chambersburg, Columbus, and Indianapolis he was a deaf-mute. He swindled the state geologist of Indiana out of over a hundred dollars' worth of scientific books. From the Cleveland historical society's rooms he obtained Indian relics of great value, and in Cincinnati, minerals and fossils which he converted into cash. He has been permitted access to several museums, public and private, from which he has succeeded in abstracting valuable specimens, and sold them. Any information in regard to the real name and residence of this man is much to be desired.

F. V. HAYDEN.

AN INTERNATIONAL SCIENTIFIC ASSOCIATION.

THE coming of the British association in August next to this continent to hold its meeting will result, it is hoped, in bringing the scientific representatives of two great nations twice together, — once at Montreal; and later, again, at Philadelphia. The interest felt in these two gatherings is very great, and rapidly increasing as the time approaches for their occurrence. It is realized that they will be very important and delightful. Both meetings will be international in character; and the pleasant anticipations formed in regard to them suggest the advisability of establishing some permanent organization which may insure

the recurrence of similar opportunities in the future.

There are many persons who have long wished that an international scientific association should be formed, where those of similar pursuits could meet one another, and, as it were, exchange thought between the nations. All acknowledge that the chief value of the large general associations lies in the stimulus of personal intercourse and discussion; and this would doubtless apply still more decidedly to an international society. The principal purpose of its meetings would be, we doubt not, to secure that stimulus.

An international scientific association would necessarily be largely European, and Americans would have to cross the ocean to attend its sessions. But with our habits of active travel, this necessity cannot be thought likely to prove a serious obstacle to our active participation in the association; which might, too, at some time, be induced to follow the example of the British association, and meet upon our side. Perhaps no opportunity will soon recur so favorable for the formation of the suggested association as the meeting at Philadelphia, and it seems very possible that the initiative may be there taken. The two English-speaking races can then act in concert, and, by a double appeal, more easily achieve the result than either could alone. America takes no share in the international complications which agitate Europe, and is therefore a friend with all, and might, on that account, the more readily inaugurate such a general movement.

Some limitation would necessarily be made upon the membership of the body suggested, confining it, perhaps, to original investigators. It is a question how far the indiscriminate presentation of scientific communications could be made feasible; for, if the whole of the annual additions to science were to be presented, the association would sit the entire year. Obviously some restrictions are requisite: their character must be decided by discussion and experience. Thus, formal addresses upon special subjects, or discussions limited to specified topics, might serve the purpose; or it might be considered wise to follow the example of the new Society of naturalists, which devotes its attention to the ways and means, the practical technique, rather than the results, of science. We hope that the plan we have briefly indicated will meet at least with consideration, and awaken discussion, so that it can be ascertained whether it ought to be pursued farther. It is too early yet to venture upon any definite proposals.

THE ALASKA MILITARY RECONNOISSANCE FOR 1883.[1]

LEAVING Tahk-o, the Yukon, for the first time, assumed something of a riparian air, the draining river being nine miles long. It is from three hundred to four hundred yards in width, very swift, and the first part of its course full of rocks and great bowlders, that make its navigation hazardous for even a stanch raft. On its right-hand bank stood a roughly built Tahk-heesh house, the only one on this part of the Yukon River for hundreds of miles on either side; and even it was deserted. The next lake was nearly thirty miles long, and appreciably wider than those through which we had sailed. I called it Lake Marsh, after Professor Marsh of Yale college.

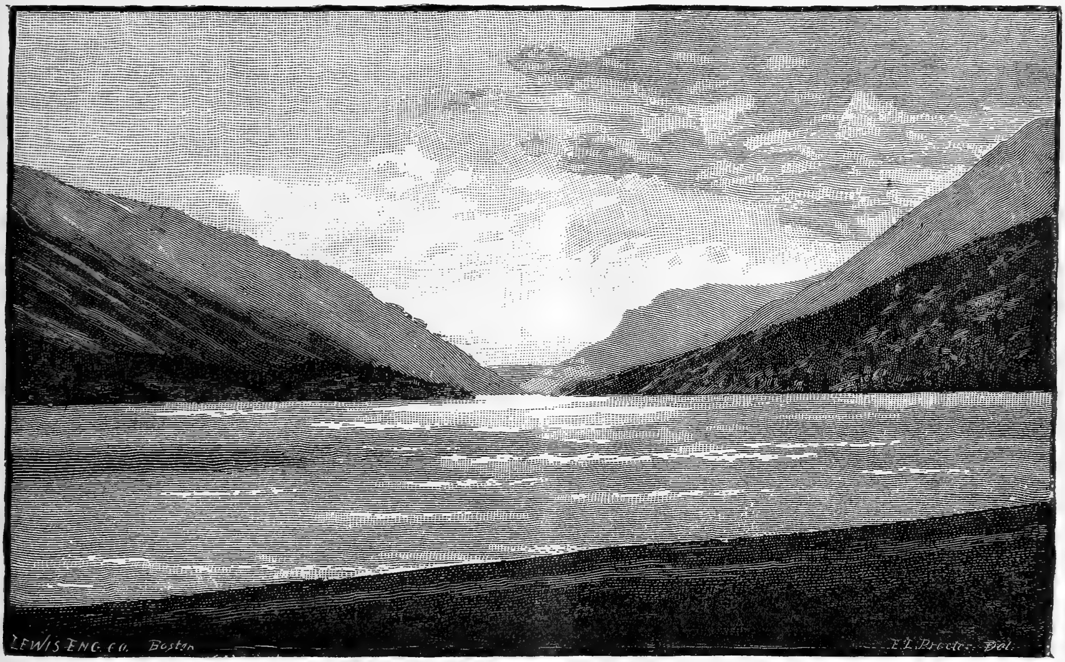
I have spoken of a great number of glaciers that were constantly encountered, and the white condition of the water emanating from them. In Lake Marsh the water near the shores was very shallow, owing to large deposits of this fine glacier mud; and we often found it impossible to get much nearer the beach than sixty to eighty yards, although our craft drew less than two feet of water. When a high wind lashed the lake into waves, these mud deposits gave a clear-cut outline between the whitened water within their exterior edges and the deep blue water beyond, that showed in many places an extension of the deposits of four hundred to five hundred yards from the beach. It is possible that the stages of water may vary in Lake Marsh at different seasons sufficient to lay bare these mud-banks, or cover them so as to be navigable for small boats; but there seemed to be a wonderful uniformity in the depth of the water over these banks in every part of the lake, being about eighteen inches. Through this tenacious mass, that even threatened to pull off our rubber boots, we would have to carry our camping-material each evening as we went into camp, and each morning as we broke it for our departure. The trees on the hills overlooking the lake, as had been often noticed before on the upper waters of the Yukon, all leaned more or less conspicuously towards the north, or down stream, thus plainly showing the prevailing direction of the stronger winds. Faint signs of terraces were still to be seen on the hillsides; but they were lower, nearer together, and not so well marked as on Lake Nares. The level ridges on the eastern hills were still covered with the luxuriant yellow grass of last year's growth, and, as we viewed

[1] Continued from No. 55.

them from the lake, turned one's thoughts to the stubble fields of grain in temperate climes.

On the 28th, on Lake Marsh, a spirited rain and thunder shower lasted from 12.45 P.M. to 2.15 P.M., and is, I believe, the first thunder-storm recorded on the Yukon, it being unknown on the lower river, according to all accounts. It brought us a head wind; and, after dying out, a favorable breeze sprang up, and kept us going until 12.30 next morning, so essential was it for us to take advantage of all favorable wind. At midnight it was so light, however, that but one star could be seen in the unclouded sky, — the planet Venus. For the first time bathing was possible in the lakes, although not pleasant, except on very warm, still days.

The northern shores of Lake Marsh are especially flat and boggy, making our camps very disagreeable. Our rough mode of navigation also suffered from the ceaseless banks of 'glacier-mud' as we approached its outlet, most of which was probably deposited by a large river (the McClintock[1]) that here comes in from the east, — a river so large that we were in some doubt as to its being the outlet, until its current settled the matter by carrying us into the proper channel. This channel much more closely resembled some of the streams in temperate climes than any we had met. Its flanking hillsides of rolling ground were covered with spruce and pine, here and there breaking into pleasant-looking, grassy prairies, while its own valley was densely wooded with poplar and willows of several varieties. These latter, in fact, encroached so closely upon the very water's edge in such impenetrable confusion that camping-places were hard to find, unless a spur from the hills, covered with evergreens, wedged its way in on the river's face to break the continuity of this barrier to a night's camping-place. The raft's corduroy deck of pine poles often served us for a rough night's lodging.



LAKE BENNETT FROM PAYER PORTAGE.

Iron-capped mountains on the right, covered with fog.

Muskrats were plentiful in this part of the river, and in the quiet evenings a number could be traced at once by their wedge-shaped ripples as they were swimming about. Small broods of ducks were also occasionally noticed, and numbers of the great American diver were seen on almost all the lakes.

On the 1st of July, with a Tahk-heesh Indian as a guide, we approached the great rapids of which we had heard so much. An inspec-

[1] In honor of Vice-Admiral Sir Leopold McClintock, Royal navy.

tion of them showed that they were really quite formidable and dangerous for any sort of craft whatever. Nearly five miles in length, the first half or three-quarters of a mile is through a cañon from fifty to sixty feet deep, where the original stream is contracted to one-eighth or one-tenth its former width, and through which the river fairly boils. This cañon, the only true one on the Yukon River,[1] is composed of basaltic columns, so regular that they are not unlike representations of the Giant's Causeway on the Irish coast. In the centre of its length it expands into a large, circular, basaltic basin seventy or eighty yards wide, or double the width of the cañon proper; and here the water's edge could be reached on the west shore. After leaving the cañon, the channel expands into a sheet of rushing rapids, often three hundred to four hundred yards wide, broken by rocky bars into frothy chutes full of bowlders and foaming and bristling dams of lodged and water-logged timber, ten times more dangerous than the cañon itself, although not so in appearance. About four miles of this brings us to the end, where the river, again contracting into a few yards, shoots down a cascade so narrow and swift that the ascending banks of rock are covered with the rushing current that falls over their sides in sheets, and makes it a veritable funnel of foaming water.

Through this cañon, rapids, and cascade we shot our raft July 2, losing the two side-logs in a collision in the cañon with its basaltic columns, and, just below the cascade, hauled in for repairs, and to redeck the raft with the fine straight spruce and pine poles that we here found in large quantities, thoroughly seasoned by some fire that had destroyed them two or three years before. Like all the Coniferae growing in dense masses, these timber districts have their periodical devastations of fire; and years after, the fallen timber, coupled with the new growth, makes pedestrianism border on the impossible.

A few Tahk-heesh Indians had been employed by us in our labors around the Miles' cañon and rapids;[2] and I was forced to contrast their great kindness to each other, and especially to their women, with the conduct, the very reverse, in the Chilcats. These Chilcats, in tracking canoes up the Dayay, refused to convey the loads of their fellows not provided with these craft, although to have done so would have necessitated no extra labor, thus compelling the latter to carry their packs as they did over the Perrier Portage. They would not even ferry them over the swift Dayay, forcing them into long détours or perilous crossings up to their middle in the rapids. Even in cases of sickness they would do nothing for their comrades, unless compensated by a part of the payment.

Grayling were caught in large numbers in and around these rapids, some four hundred to five hundred being secured by the party. They were also caught in straggling numbers from Lake Bove, until White River, below old Fort Selkirk, was reached. Moose and caribou (woodland reindeer) tracks were abundant, but no animals seen; and the dense swarms of mosquitoes were amply sufficient to convince any one that the tracks of an animal were the only part that could remain in the country during this part of the year. These pests, coupled with the gnats, were the greatest discomfort that the party was called on to bear; and there was no cessation from them the whole length of the river, although the upper part was much the worst. The dense smoke of the camp-fire was always crowded with the party whenever the wind was not blowing, and meals were eaten under mosquito-bars for protection. From the time the snow is half off the ground until the first severe frost comes, no one disputes the valley with them. Dogs have been known to be killed by them; and, after two or three months of the closest intercourse with them, I was willing to believe the Indian stories that they even slay the brown and grizzly bear of these regions.[1]

I noticed that a Tahk-heesh Indian, in arranging his head and breast-band for a load, pulled the former forward until taut, and the latter just far enough beyond to allow the width of his hand between them, when they were considered adjusted. I had also noticed this among the Chilcats.

One evening, about eight, while encamped some four hundred or five hundred yards below the cascades in the Miles' rapids, we could hear dull, heavy concussions in single blows, at intervals of every two or three minutes. It was noticed by more than one, and thought by some to be possibly distant thunder, although it sounded strangely unlike that noisy

[1] I mean by a *true cañon* one with perpendicular or practically perpendicular sides, although every precipitous and deep valley in the west is often called a cañon. With such an understanding, it would be impossible to tell where a cañon ended and a valley commenced.

[2] Named after Brevet Major-Gen. Nelson A. Miles, U.S. Army, commanding department of Columbia, in which Alaska is situated.

[1] This statement is asserted as a fact by some Indians and white traders, who state that the bear, in trespassing upon a swampy habitation of mosquitoes, instead of seeking safety in flight, rears upon his hind-quarters, and fights them bear-fashion, until his eyes are closed by their repeated attacks, when starvation is the real cause of death.

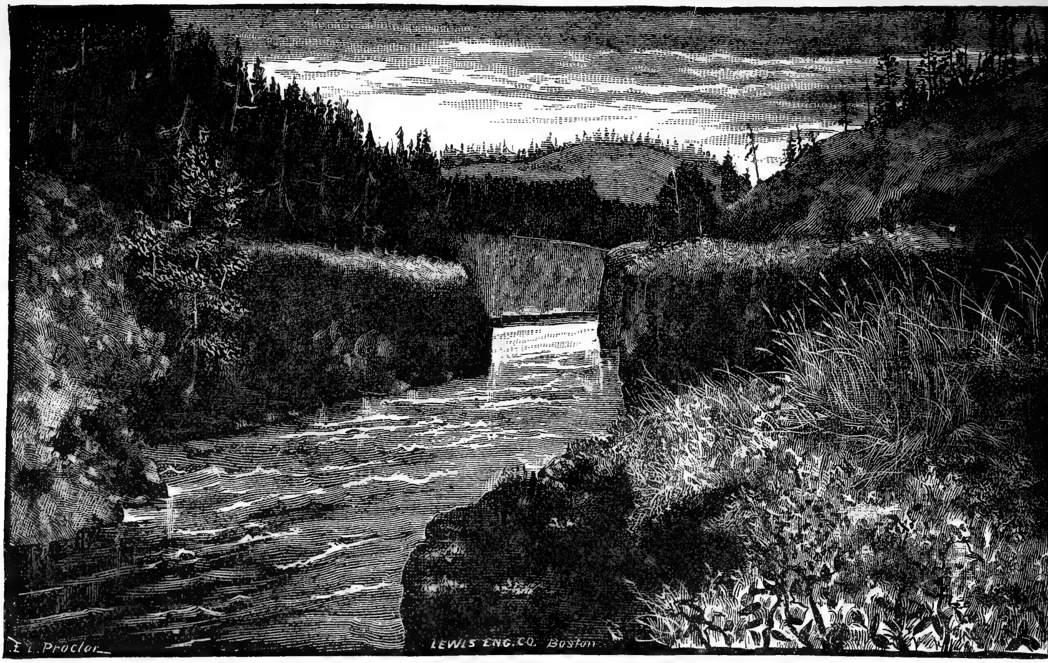
element; and the sky, too, was cloudless. A very light series of earthquake-shocks also seemed a poor theory; and there was but little left to attribute it to, except the cascades, which, I believe, have been known to cause earth-tremblings and analogous phenomena.

About noon on the 5th of July we passed the Tahk River (Tahk-heen-a of the Indians) coming in from the west, and which is probably two-thirds the size of the Tahk-heesh, as the Indians call the Yukon proper. While the former river is the smaller, its bed and valley apparently determine the general characteristics of the stream farther on, the Yukon here noticeably changing from high bold bluffs of clay to lower shores wooded to the water's edge. The last of the chain of lakes was reached the same day, and we were prevented from taking advantage of a good wind by a three-hours' detention on a sand-bar that the river had made almost entirely across its mouth. This lake was called by the Indians Kluk-tas-si; and, as it was one of the very few pronounceable Indian names of this section of the country, I retained it, although it is possible that this may be the Lake Labarge of some books, the fact that it is the first lake above old Selkirk being the only data in its favor, while its relation to other important points are equally against it. Like Lake Marsh, it is full of mud-banks; its emerging waters being clear, while its incoming supplies are loaded with deposit. So full of these is Kluk-tas-si, and so much more contracted is the water-way through them, that I think we were able to detect a slight current when making our way along in the blue water. This was especially noticeable when the wind died down to a calm. Despite all this, Kluk-tas-si was better for making landings on its shores than Marsh. It seems that it must be a mere matter of short geological time when these lakes will be filled by deposits, and converted into limited parts of the river. Such ancient lakes are noticeable in the course of the great stream farther on. The west bank of the last lake is very picturesque about fourteen or fifteen miles from its entrance, where large towers of red rocks throw up their conspicuous flanks on what seems to be a well-marked island, but which is really a part of the mainland, our Indians assured us. Here, also, comes in a river, say the same authorities, abounding in banks of the same material, and called by them the Red River. The frequency of this name in geographical nomenclature was sufficient reason to abandon it; and I named the rocks and river (the latter we never saw) Richthofen rocks and river, after Freiherr von Richthofen of Bonn, well known in geographical science. The right bank seems to be made of rounded hills of gray limestone, being picturesquely striped with the foliage of the dark evergreens growing in the ravines. A number of salmon-trout were caught in this last lake (the first one was secured in Lake Bove), the largest of which weighed over eight pounds, the limits of our pocket fish-scales.

On the 9th, at 10.30 A.M., we bade adieu to lake navigation, our hearts much lighter for the fact. That same day we saw a grizzly or immense brown bear, whose rapid departure gave us very little chance for close inspection. Our Indians say in regard to the scarcity of game, that the moose and caribou follow the snow-line as it retreats up the mountains in the spring and summer; also that the moose do not build 'yards' in the winter, as in Maine and the Canadian provinces. On the same day we passed the mouth of the Newberry River (after Professor John S. Newberry of New York), coming in from the east, about a hundred and twenty-five yards wide; and the Yukon at once became very much deeper, swifter, and the water of a darker hue, showing that the Newberry drained a considerable amount of 'tundra' land, or land where the water, saturated with the dyes extracted from dead leaves and mosses, is prevented from clarifying itself by percolating through the soil, by an impervious substratum of ice, and is carried off by superficial drainage directly into the river-beds. Forty miles farther on, measured along the stream, comes in the D'Abbadie,[1] over a hundred and fifty yards wide at its mouth, and said to be over two hundred and fifty miles in length. It notes an important point on the Yukon River as being the place at which gold in placer deposits commences. From the D'Abbadie to the very mouth of the great Yukon, a panful of 'dirt' taken from almost any bar or bank with any discretion, will, when washed, give several 'colors,' to use a miner's phrase. Another forty miles, and the Daly River comes in from the east, forming, with the Newberry and D'Abbadie, a singular triplet of almost similar rivers. The last I have named after Chief-Justice Daly of New York, a leading patron of my Franklin search expedition.

The prevalence of the larger rivers to the east showed this to be the main drainage area of the upper Yukon, a rule broken only by the Nordenskiöld River coming in from the west;

[1] M. Antoine D'Abbadie, membre de l'Institut de France, Paris.



VIEW IN MILES' CAÑON FROM ITS SOUTHERN ENTRANCE.
The only cañon, and head of navigation, on the Yukon, 1866 miles from Aphoon mouth.

fifty miles beyond the Daly, and the peer of any of the three. We passed its mouth the 11th, and that same day our Indians told us of a perilous rapid ahead that the Indians of the country sometimes shot with their small rafts; but they felt very anxious in regard to our very bulky and clumsy one of forty-two feet, as there were some sharp bends to make. Reaching the rapid on the 12th, I found it to be a contraction of the river-bed into about one-half its usual width of five hundred to seven hundred yards, and further impeded by a number of massive trap rocks, thirty to forty feet high, lying directly in the channel, and really converting it into three or four well-marked channels, the second one from the east being the usual one used by the Indians, but rejected by us on account of a necessary sharp turn. We essayed the extreme right-hand passage, although running waves three and four feet high were seen in its boiling current, but still the straightest, and therefore the best. On these rocks innumerable numbers of gulls had sought a breeding-ground, safe from all intrusion, and saluted us with a perfect din of screamings as we rushed by. This extreme right-hand channel through which we shot, I believe could be ascended by a river-steamer with a steam windlass, a sharp bend in the river-bank giving a short and secure hold; and, if I am right in my conjectures, Miles' Cañon and rapids mark the head of navigation on the Yukon for very light-draught but powerful river-boats, or a total navigable distance of eighteen hundred and sixty-six miles from the Aphoon mouth. I named this picturesque little rapid after Dr. Henry Rink of Copenhagen, a well-known Greenland authority.

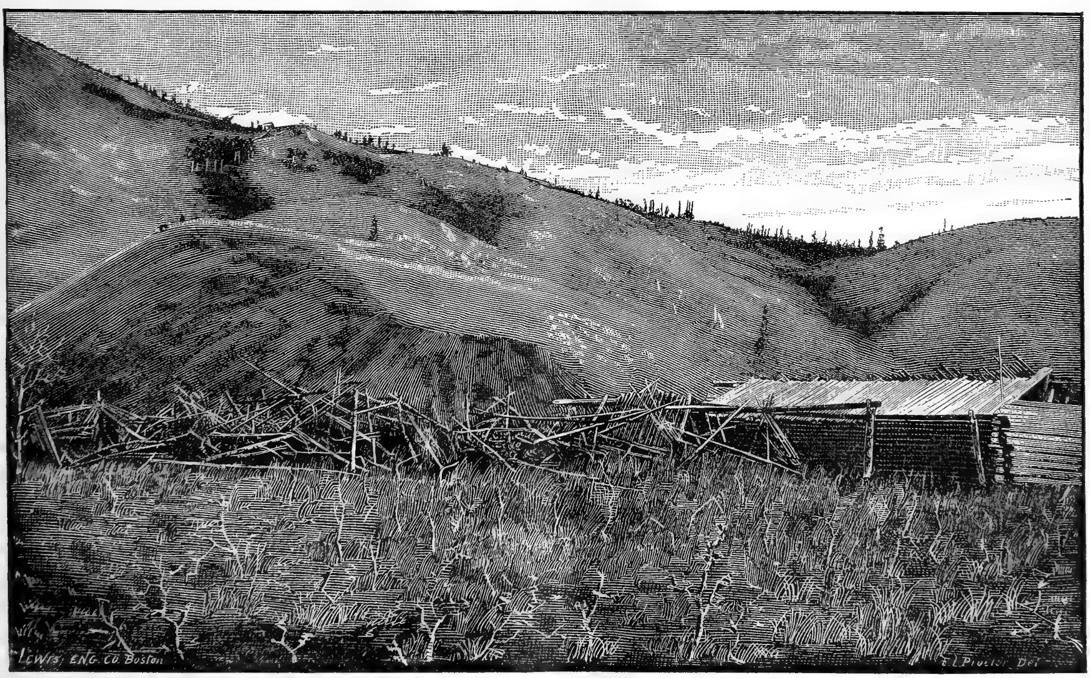
After the Yukon receives the many large rivers I have noticed, it swells out into quite formidable proportions, interspersed with many islands, all of which are so loaded with great piles of driftwood on their upper ends, that, when in one of these archipelagoes, the scene up and down the river is quite different. The river also becomes very tortuous in many places; and at the mouth of the Nordenskiöld a conspicuous bald butte could be seen directly in front of our raft no less than seven times, on as many different stretches of the river. I called it Tantalus Butte on the map.

The day we shot the Rink Rapids we also saw our first moose ploughing through the willow-brush like a hurricane in his endeavors to escape, — an undertaking in which he was successful. That same night we camped near the first Indian village we had met on the river, and even it was deserted. It is called Kit[l]-

ah-gon (meaning the place between high hills), consists of one log house about eighteen by thirty, and a score of the brush houses usual in this country; that is, three main poles, one much longer than the rest, and serving as a ridge-pole on which to pile evergreen brush to complete the house. This brush is sometimes replaced by the most thoroughly ventilated reindeer or moose skin, and in rare cases by an old piece of canvas. Such are the almost constant habitations of these abject creatures. In the spring Kit^{l}-ah-gon is deserted by the Indians, who then ascend the river with loads so light that they can be carried on their backs. By the close approach of winter-time they have worked so far away, accumulating the little salmon, moose, black bear, and caribou, on which they are to subsist, that they build a light raft from the driftwood on the islands, and float down to live in squalor through the winter. These rafts are almost their sole means of navigation from Miles' Cañon to Fort Selkirk, and the triangular houses almost their only abodes; and all this in a country teeming with good enough timber for log-houses, and plenty of birchbark for canoes. Kit^{l}-ah-gon is in a beautiful large valley,[1] as its name would impart; and I was surprised to see it drained by so small a stream as the one, but ten or fifteen yards wide, which goes out at its foot. Its proximity to the Pelly forbids its draining a great area, yet its valley is much the more conspicuous of the two. Photographs of it and adjacent scenes on the river were secured before departing, and a rough 'prospect' in the valley showed 'color' enough to brighten the hopes of some enthusiastic miner for something he would prize more highly.

[1] Von Wilczek valley, after Graf von Wilczek of Vienna.

From Kit^{l}-ah-gon to old Selkirk is but a little over twenty miles; and the river is so full of islands in many places, that for long stretches we could hardly see both banks at a time. This, I think, is one of the ancient lakes to which I have alluded, although the report of a professional geologist would be needed to settle such a matter. I was very anxious to determine the relative sizes of the two rivers that joined just above Selkirk, as upon this determination rested whether the Pelly or the Lewis River of the old Hudson-bay traders was the Yukon proper; and I was fully prepared to make exact measurements, soundings, rate of current, and other data if necessary, to settle the point. This was only needed in a rough manner, however, as the preponderance of the Lewis River was too evident to require any exactness to confirm it.



INDIAN VILLAGE OF KIT^{L}-AH-GON IN THE VON WILCZEK VALLEY.

It is deserted in summer, and occupied in winter.

The ratio of widths is about five to three, with about the ratio of five to four in depth; the latter, however, being a very rough approximation. At old Fort Selkirk nothing but the chimneys, three in number, are left standing: the fate of this post has been alluded to in an earlier part of the article.

The latitude of Fort Selkirk is 62° 45′ 46″ north, and its longitude 137° 22′ 45″ west (Greenwich). Altogether on the Yukon River, this far, there had been taken thirty-four astronomical observations, four hundred and twenty-five with the prismatic compass, and two for variation of compass. I hope they have been sufficiently accurate; at least, to subserve all practical purposes of exploration in this country, until more exact surveys are demanded by the opening of some industry or commerce, should that time ever come. No meteorological observations were taken, the party not being furnished with instruments, and the rapid passage through a vast tract of country making their usefulness to science highly problematical. The nearest point to the upper Yukon, at which regular observations of this character are recorded, is the Chilcat salmon-cannery of the North-west trading company on Chilcat Inlet. The two are separated by the Kotusk Mountains, making meteorological inferences, therefore, very unreliable. Nearly a hundred botanical specimens were collected on the upper Yukon, and have been placed in the able hands of Mr. Watson, curator of the Harvard herbarium, for analysis. While only a limited and crude amateur's collection, it may throw some little light on the general character of the flora, as limited to the river-bed, which we seldom left in our more important duties connected with the main object of the reconnoissance.

The map is necessarily condensed for so large an area; and having been made hurriedly, and expressly for this article, it is not wrought so much for topographical effect as exactness within the limits possible under such circumstances. The map which will accompany my official report is on a much larger scale, and much better prepared in details. To Mr. Homan, my topographical assistant, is due all the credit relating to the map-making department, except simply the astronomical observations, and in those requiring an assistant, when he acted as recorder. The above account has mostly been taken in chronological sequence from my daily journal, and matters of the same character have thus been separated in different parts of the article. If, with all these defects, I have made clear my small addition to geographical research to the readers of *Science*, I shall feel deeply repaid for the great labor I had in securing it.

In my geographical nomenclature I have tried to observe the following rules. Wherever a descriptive name would assist any future traveller in identifying the object, I have applied it, to the exclusion of all others, Indian or civilized; as, Red Butte, Bald Hill, Cone-Hill River, Haystack Island, etc. Where Indian names are simple, I have tried to retain them, as Kotusk, Tahk-o, Tahk-heen-a, Kluk-tas-si, Dayay, etc. In all other cases, where the object was deserving of being named, I have not hesitated to attach the names of men worthy of such distinction, both personal friends in all branches of science, and those who have done something for geographical research, and without regard to country. In my larger map I have also added the native names, where they could be secured.

The total length of part first, the part explored and surveyed by this reconnoissance, was 538.8 miles; the total length of the raft-journey on part first, from camp on Lake Lindeman to Fort Selkirk, 486.8 miles; the total length of the raft-journey on Yukon River, from Lake Lindeman to Nuklakayet (being the longest raft-journey in the interest of geographical science), 1,303.2 miles; the length of Yukon River, 2,043.5 miles.

FRED'K SCHWATKA,
Lieut. U. S. Army.

NOTE ON THE FLORA OF THE UPPER YUKON.

LIEUT. SCHWATKA was able to make a small botanical collection from about the head waters of the Yukon, which is of considerable interest as an indication of the climate of the region, and as showing the range northward into the Yukon valley, of some species previously known scarcely beyond the British boundary. Lieut. Schwatka, ascending from the head of Chilcoot Inlet, crossed the main coast-range by the Perrier Pass at an altitude of 4,100 feet, coming at once upon the source of the Yukon River, in latitude 59° 40′. A descent of twelve miles brought him to Lake Lindeman; and upon the borders of this and other lakes within a distance of twenty-five miles, nearly equally on both sides of the sixtieth parallel, the larger part of the collection was made, between the 12th and 15th of June. The specimens gathered even at this date were in full bloom, excepting a few indicated in the following list

by parentheses, and the sedges and grasses, which were well developed.

Anemone parviflora.
Aquilegia formosa.
Aconitum Napellus, var.
Barbarea vulgaris.
Arabis petraea.
Cardamine hirsuta, var.
Viola cucullata.
Lupinus arcticus.
Rubus Chamaemorus.
(Poterium Sitchense?)
Saxifraga tricuspidata.
Saxifraga leucanthemifolia.
Parnassia fimbriata.
Ribes rubrum.
Epilobium spicatum.
Epilobium latifolium.
(Heracleum lanatum.)
Cornus Canadensis.
Antennaria alpina.
Arnica latifolia.
(Senecio triangularis.)
Vaccinium parvifolium.
Arctostaphylos Uva-ursi.
Bryanthus empetriformis.
Kalmia glauca.
Ledum latifolium.
(Moneses uniflora.)
Pyrola secunda.
Dodecatheon Meadia, var.
Polemonium humile.
Mertensia paniculata.
Polygonum viviparum.
(Betula glandulosa.)
(Alnus viridis.)
Salix glauca.
Salix Sitchensis.
Habenaria dilatata.
Streptopus roseus.
Carex (2 sp.).
Deyeuxia Langsdorffii.
Festuca ovina.
Lycopodium complanatum.
Lycopodium annotinum.

The rest of the collection was made as opportunity offered, during the descent to Fort Selkirk in latitude 62° 45′, which point was reached on the 13th of July. It included the following species: —

Anemone multifida.
Ranunculus Flammula, var.
Erysimum parviflorum.
Cerastium arvense.
Arenaria lateriflora.
Arenaria physodes.
Montia fontana.
Linum perenne.
Hedysarum boreale.
Rubus arcticus.
Fragaria vesca (?)
Potentilla fruticosa.
Amelanchier alnifolia.
Parnassia palustris.
Bupleurum ranunculoides.
Galium boreale.
Aster Sibiricus.
Achillea millefolium.
Artemisia vulgaris.
Arnica alpina.
Arnica Chamissonis.
Pyrola rotundifolia, var.
Primula Sibirica.
Myosotis sylvatica, var.
Pentstemon confertus.
Pentstemon glaucus (?).
Pedicularis flammea.
Chenopodium album.
Polygonum aviculare.
Zygadenus elegans.
Hordeum jubatum.

The species new to so northern a latitude are marked by italics. The season appears to have been as forward as I found it in 1868 in the lower mountain ranges rising from the plateau of western Nevada in latitude 40°.

SERENO WATSON.

THE INTELLIGENCE OF SNAKES.

NEITHER among the scanty early references to the serpents found in New Jersey, nor in more recent herpetological literature, are there to be found statements that bear directly upon the subject of the intelligence of snakes. Gabriel Thomas, writing of West New Jersey as long ago as 1698, quite ignores the fourteen species with which we are favored. Thomas Campanius, in his history of New Sweden, published in 1702, and which is based on the notes made by his grandfather during his brief stay in Pennsylvania sixty years before, also ignores our harmless snakes, but remarks of the rattlesnake (Crotalus horridus), "It has a head like a dog, and can bite off a man's leg as clear as if it had been hewn down with an axe." What may we not expect, when such statements as this are made by men of intelligence? Assertions equally absurd are not uncommonly made, even in these later days, when a correct knowledge of our common animals is supposed to prevail.

Nearly half a century later than the date of publication of Campanius' history, Peter Kalm, the Swedish naturalist, travelled in New Jersey, and spent much time, particularly in the southern counties of the state. In his entertaining volumes, he has made many references to our snakes, although not enumerating all of them, and mentioning some that certainly do not now exist. This author relates several wonderful stories of the fierceness of the black snake, as they were told to him, and likewise gives his personal experience with this same serpent, which, to his surprise, did not accord with what he had heard. The reason is plain enough. Kalm desired to know the truth, and took the experimental way of learning it. His knowledge of the snakes was gained by familiar out-of-doors intercourse with them, and it has stood the test of time. All that was needed, when he wrote, was the moral courage to say to the narrators of the marvellous stories, 'You are mistaken;' or perhaps, more wisely, he might have kept silent. The most conscientious man, if afraid of snakes, cannot tell the truth about them; and even in the case of the truly poisonous species, it is well to remember that 'the devil is not so black as he is painted.' Stress has been laid upon the exaggerated statements of authors when treating of snakes, for the reason, that, if there were any foundation for the marvellous stories narrated, it would prove conclusively that the serpent was indeed wise. But setting aside all the literature of the subject, and going directly to the woods and fields, what evidence do we find there of the intelligence of snakes?

On the farm of the writer there have been found eleven species of snakes, which is but four less than the whole number found in New Jersey. Of these eleven species, no one is venomous; and, it may be added, all are perfectly harmless, and, indeed, cowardly. It is true that when cornered they will show fight,

but it is the veriest make-believe; and it is very questionable if there is a snake among them all which could harm the smallest child, even if disposed to do so. This is strangely at variance with the current newspaper stories, I know; but those, like the anecdotes related by Kalm, are simply not true.

Of our common snakes, the most formidable in appearance is the black snake (Bascanion constrictor), and of this species scores of most wonderful stories have been told; yet the species is really very cowardly, and not disposed to resent interference at any time. It is, however, probably the most active, as it is the largest, of our serpents, and therefore is one well calculated to exhibit evidences of the possession of intelligence, and the best to study in regard to this subject. What, then, do we learn, when we seek out these black snakes in their chosen haunts? To find them, one must proceed cautiously; for they are possessed of a quick sense of hearing, and are on the alert the moment any suspicious noises are heard. Is it for this reason that they are considered quite rare in many places where they really are abundant? They have apparently learned wisdom by experience, and, knowing that if discovered they will be pursued, conceal themselves quickly if they suspect danger. I can in no other way satisfactorily describe such actions of these snakes as I have often witnessed; and the use of the phrase 'learning wisdom,' and of the word 'suspect,' implies necessarily the possession, on the part of the snakes, of a considerable degree of intelligence. How far the black snake is cunning, I have not been able to determine; but a chance remark in Heckewelder's 'Indian nations' would seem to indicate that the Indians had long been convinced that it was a cunning serpent, and I am disposed to accept their testimony in such matters as essentially correct. Heckewelder says the Indians gave to Gen. Wayne the name of 'Black Snake,' "because they say he had all the cunning of this animal, who is superior to all other snakes in the manner of procuring his food. He hides himself in the grass, with his head, only, above it, watching all around to see where the birds are building their nests, that he may know where to find the young ones when they are hatched."

Assuming this to be true, we have here an instance, not only of cunning, but of a very excellent memory. This seems incredible; but Mr. Romanes, in his volume on animal intelligence, remarks that snakes "are well able to distinguish persons, and that they remember their friends for a period of at least six weeks." If, therefore, a tamed snake can remember a person for six weeks, there is nothing very remarkable in its retaining the localities of birds' nests for a shorter period; for, between the building of the nest and hatching of the eggs, less than half that time elapses. The elaborate treatises on the power of black snakes to charm birds and squirrels may be passed by in this connection. That these snakes frighten little birds out of their wits by staring at them is occasionally true; but that the snake intentionally 'charms' its prey, as has been so elaborately and pathetically described, is sheer nonsense. Still, considering the black snake in a practical way, and seeing him under ordinary, not extraordinary, circumstances, it must be admitted that he possesses a considerable degree of intelligence. Indeed, the fact that this snake has, notwithstanding incessant persecution, been able to hold its own in the most thickly settled neighborhoods, is of itself a conclusive argument that it possesses decided intellectual power. It has at least sufficient wit to elude a host of enemies.

A far more abundant species, and one that is even better known and more dreaded than the black snake, is the harmless and very resentful hog-nosed snake (Heterodon platyrhinos). It has a variety of common names, — such as 'adder,' 'viper,' and 'flat-head,' — of which the last alone is at all appropriate. It is true that it flattens its head, hisses loudly, springs menacingly, and snaps fiercely; but it is harmless nevertheless.

As an object of study, it presents much that is of peculiar interest. Without fangs, or even teeth of sufficient length to produce a wound beyond a mere pin-prick, it presents the outward appearance, and has the pose and movement, of the deadly rattlesnake. Wholly unable to inflict the slightest injury, it has always puzzled me to understand why it should not, like all our other snakes, seek safety in flight. May we hold that it realizes the full meaning of the peculiar powers of the venomous serpent it mimics so admirably, and trusts to its being mistaken for a rattlesnake? Indeed, this mimicry has been perfect in some instances that I have witnessed; inasmuch as the tail of the snake was rapidly vibrated against dead leaves, and so produced a sound that was strikingly similar to that of the rattlesnake. This similarity was, of course, accidental, as it was by mere chance that dry leaves were lying about; but, at various other times, I have noticed that the tail was held in the same position, and vibrated in precisely the same

manner, as that of the rattlesnake. In these instances I thought I detected a faint whirring sound, or a buzzing; but on this point I am not positive.

Mimicry on the part of snakes is a ready way of explaining some of their habits; but, even when accepted, it remains to be shown how it originated. Is there any evidence that in former times the hog-nosed snake and rattlesnake were intimately associated? I find none, and certainly at present the two species are not found together. I have endeavored to detect something in their habits, haunts, and anatomy, that could throw light upon this question, but as yet all in vain. I can only say that the snake is in appearance a deadly rattler, but that it has neither the rattles nor the fangs. A veritable impostor is he, sailing under false colors throughout his whole life. How far has conscious mimicry had to do with this? If any thing, a high degree of intelligence is implied; but, even if the peculiar habits of the species were acquired without reference to other snakes, does not the fact that it relies upon worthless means of safety imply that it recognizes them as calculated to strike terror in the breast of its tormentor? That this snake should generally refuse to seek safety by running away, but depend upon actions which cause no harm to its enemies, seems, at first glance, to be the height of stupidity; but, when we recall the fact that it is a perfect imitation of the defensive movements of a venomous species found in the immediate neighborhood, then the question arises whether it may not be conscious imitation. If so, this snake, which is really quite sluggish in its movements, may be far more cunning than we suspect.

There is another species that to a certain extent imitates the rattlesnake, but whether intentionally or not, remains to be determined. This is the milk snake (Ophibolus doliatus). This species, when found in the woods coiled upon a heap of dead leaves, will often closely imitate the peculiar rattle of the Crotalus by vibrating the tail with great rapidity, and in such a manner as to strike the leaves beneath it. This I thought to be accidental in the case of the hog-nosed snake, but believe to be intentional in this instance. I do not go so far as to state that it is an intentional imitation of the rattle of the Crotalus, but that the snake vibrated its tail against the dead leaves that a decided volume of sound might be produced. This implies that it believed that a defensive pose at the time, coupled with a rattling sound, would cause the intruder to withdraw: at least, it depended upon them rather than upon running away, when surprised. We certainly have, in such cases, exhibitions of choice, on the part of snakes, between two means of defence when overtaken by enemies. Does not the exercise of choice between two equally available means of accomplishing an object imply the possession of a considerable degree of intelligence? A beautiful green snake (Liopeltis vernalis), which I kept in semi-confinement for several months, exhibited many evidences of considerable intelligence. It became very tame, and evidently recognized me. Although allowed considerable liberty, it did not seem to be very active during the day, but was restless in the evening. It seemed to be more sensitive to cold than any of our other snakes, and remained under its little blanket when the day was rainy, or a strong east wind prevailed. It fed upon flies, which it would take from my hand, seizing them very leisurely, and swallowing them deliberately. There was nothing of the snap and gulp of a salamander or toad about the process. When, however, the snake went fly-hunting on its own account, there was a very different state of affairs. There was still great deliberation, but only until the moment for action arrived; and then, with a snap, the fly was gone.

Occasionally this pet snake would creep among a number of pots of flowers, and coil about the green branches. At such times it would frequently extend some three or four inches of its body outward and beyond any support, and thus remain, as rigid and apparently lifeless as a twig. This, probably, was a habit common to the snake when free; but why it should be indulged in under such changed surroundings, I cannot imagine. Certainly it was not for the sake of seizing its food; for I noticed that the snake, after taking a hearty meal, would assume this position, and that it did not ordinarily assume it when asleep. In its proper home, such a habit, on the part of a small snake of this color, would render it for the time very secure against such enemies as were guided only by sight. Even when standing very near the rose-bush upon which my pet rested, I found it, when in this position, a very inconspicuous object.

If this position, then, was assumed as a means of safety, it is a habit indicative of much cunning; for it acquires thereby the best chances for seeing about it, with the least probability of being noticed.

Of the seven other species of snakes found here, I have nothing special to remark. It is sufficient to say that the general impression

which these snakes give me, as I chance upon them in my rambles, is, that they are cowardly but cunning. Blessed with acute hearing and sharp sight, they use both of these faculties to the best advantage in the two important events of their daily lives, — the capture of their food, and eluding their enemies. After thirty years of familiarity with the snakes found in this neighborhood, I can truly say of them, as serpents they are *wise*, and add, they are harmless as doves.

CHARLES C. ABBOTT, M.D.

PRESENTATION OF THE RUMFORD MEDALS TO PROFESSOR ROWLAND.

THE special business announced for the meeting of the American academy of arts and sciences on the evening of Feb. 13 was the presentation of the Rumford medals, which, at the annual meeting in May, had been awarded to Prof. Henry A. Rowland of Baltimore. Before presenting the medals, the president of the academy, Professor JOSEPH LOVERING, made the following address: —

The medals awarded to Professor Rowland have been struck at the Philadelphia mint, and appropriately engraved under the direction of the Rumford committee. Their delivery to the recipient has been postponed for several meetings, under the hope and expectation that Professor Rowland would find it convenient to be present, and receive the medals in person. His attendance with us now is warmly welcomed, and adds greatly to the interest of the occasion. I ask your kind attention to a brief statement of so much of the scientific work of Professor Rowland as justifies the award of the Rumford premium, and of the relation in which these researches stand to the present condition and needs of physical science.

Astronomy, at least that part of it which relates to celestial mechanics, has presented for many generations unchallenged claims to a precision not attainable in any other science. The comparative simplicity of its problems, involving only the familiar and measurable units of mass, space, and time, has enabled it to attain and to hold this distinguished position, in spite of the fact that all the senses except vision are excluded from its study. If it has received any assistance from the experimental laws of mechanics, much more have these laws been illuminated by the motion of the planets, where friction and other resistances do not interfere.

After Grove, in 1842–43, had published his lectures on the correlation of the various physical forces; after Mayer, Helmholtz, and others had published their conclusions (the deductions partly of theory, and partly of experiment) that these different forces were mutually convertible; and after the view first seized in prophetic vision by Bacon, Locke, and Winthrop, was experimentally established by Rumford, Davy, Joule, and numerous coadjutors, and with ever-increasing clearness, that the assumed caloric was imaginary, and that heat was only one kind of motion in ordinary matter, — then it was possible to introduce unity, harmony, and precision into all the physical sciences by making the familiar units of measurement universal. As other forms of energy (mechanical, electrical, magnetic, chemical, capillary, radiant, and gravitation) can be converted, directly or indirectly, into heat-energy, heat has become a universal standard of energy, current everywhere in science, and redeemable. Hence it has become of prime importance to determine the mechanical equivalent of heat: the amount of heat, for example, which corresponds in energy to a given mass falling through a given height in a given latitude. In this way heat and all its dependencies will be measured by the units of ordinary work. For more than forty years, physicists in difference countries, and by various methods, led by Joule, have been engrossed with this measurement, reaching results which have slowly but happily converged towards a common agreement.

Professor Rowland, after a historical and critical review of the methods and results of older cultivators in this rich field, has turned up the soil anew, deepening the furrows.

The fruits of his long and patient labor were made known to the academy in 1879, in vol. xv. of the Proceedings. New apparatus was devised; the comparative merits of mercurial and air thermometers were discussed; and the various constants of science which enter into the case were re-examined. The research is a model of ingenious and conscientious experimentation, and was not published until it had received from its author the same severe criticism which he had applied to the work of others. That his final conclusion harmonizes so well with the best of Joule's, increases our confidence in both. A larger discrepancy might have given a greater show of originality; but science would have paid for the novelty by a loss of security, and another revision of the whole subject would have been entailed upon it.

When Newton announced his dynamical theory of the solar system, as simple as it was comprehensive, it made slow headway against the fanciful hypothesis of Descartes which was intrenched in all the universities of Europe. And yet Newton's theory reposed upon a firm mathematical foundation; while that of Descartes submitted to no quantitative tests, and contradicted all the known laws of mechanics. The history of astronomy from that time almost to the present moment tells of ever new victories achieved by the combined attacks of the telescope and mathematical analysis in the province of celestial mechanics, presenting the law of gravitation as supreme dictator to planetary and sidereal systems. But these triumphs, complete in their details, and grand in their cosmical range, were limited to questions which concern the distances, motions, dimensions, and masses of the heavenly bodies. The law of gravitation can assign a value to the quantity of matter in planets and binary stars; but it asks and can answer no question in regard to the quality of this matter,

only so far as a comparison of the size and mass of a body gives a measure of its density. That an instrument would be invented or developed which would complement the mechanics of the heavens by the chemistry of planets, comets, and stars, so that a physical observatory would become a necessary adjunct of the old observatory, was beyond the hope of the most sanguine astronomer, down to the moment of its actual realization.

Newton owes his singular fame, not exclusively to his discovery and expansion of the law of gravitation, but partly to his experimental researches in optics. That he did not recognize the dark lines in the solar spectrum has been explained by the statement that he was obliged to use the eye of an assistant in these experiments, on account of an injury to his own. Be this as it may, the existence of these lines was first known to Wollaston in 1802; and from that moment the spectroscope and spectrum-analysis, as we now understand them, were possibilities.

Although Fraunhofer made a careful study of these lines in 1824, and Brewster, Herschel, Talbot, Draper, and many others pursued the inquiry by way of experiment and explanation, and stood upon the threshold of a great discovery, the spectroscope and spectrum-analysis, as practical realities, date from the investigations of Kirchhoff and Bunsen in 1862. Not only does the spectroscope carry chemistry into regions tenanted only by planets, comets, stars, and nebulae, and reveal motions in the direction of the line of vision, otherwise hopelessly beyond recognition, but it competes with the ordinary chemical analysis of bodies which can be handled, and has detected new substances which had escaped the vigilance of the chemist. Some of these results can be realized with simple instruments: others require a compound spectroscope consisting of a battery of prisms. It was a great step in the way of simplicity and ease of manipulation, when the diffraction-spectrum, produced by fine lines ruled upon glass or metal, was substituted for the spectrum produced by the combined refractions of many prisms. And here we touch upon the researches of Professor Rowland in light, which enhance his claim to the Rumford premium.

Professor Rowland's improvements in the diffraction-spectrum are manifold. 1. He has substituted for the flat plate on which the grating was formerly ruled a spherical or cylindrical surface. 2. He has ruled these lines to such a degree of fineness that 5,000, or 42,000, or even 160,000, have covered only one inch. 3. This exquisite work was executed by a machine of his own invention, and produced spectra free from the so-called ghosts which result from periodical inequalities in the ruling. 4. By making the curvature of the ruled plate discharge the office of a lens, he has avoided absorption at the violet end of the spectrum. 5. By his simple mechanical arrangements, different parts of the spectrum can be photographed with a great economy of time, and with such excellence of definition that old lines are subdivided, and new ones spring into visibility: in the words of a competent authority on the subject, 'the gratings of Mr. Rowland make a new departure in spectrum-analysis.' 6. Finally, his mathematical exposition of the theory of gratings has explained observed anomalies, indicated the conditions of success, and prophesied the limits at which future improvements in spectrum-analysis must stop.

PROFESSOR ROWLAND, It is now my duty, and certainly it is a most agreeable one, to present to you, in the name of the academy, the gold and silver medals which constitute the Rumford premium. Count Rumford, in conveying this trust to the academy through President John Adams, expressed a preference for such discoveries as should, in the opinion of the academy, tend most to promote the good of mankind. The practical applications of science are

numerous and valuable, and are sure of popular recognition and reward; but they often come from the most unexpected quarters. No one can predict what wonderful points of contact may be suddenly revealed between a purely theoretical investigation and the practical utilities of life. Meanwhile, a deeper insight into the laws of the material universe, extorted from a reluctant nature only after long and patient labor and thought, and many disappointments, becomes a permanent possession for mankind; and, as long as man does not live by bread alone, it is for him a perennial blessing. The academy, in awarding the Rumford premium to you, has indicated the kind of scientific work which, in its opinion, tends most to promote the *highest* good of mankind.

I ask you to accept, with these medals, my warm congratulations, and the cordial good wishes of all the members of the academy here assembled to administer Count Rumford's trust.

On receiving the medals, Professor ROWLAND spoke as follows: —

MR. PRESIDENT, AND GENTLEMEN OF THE ACADEMY, I thank you for the honor you have conferred upon me, which I can but regard as the greatest honor of my life.

In receiving these medals, I am pleased to think that they have been conferred upon work which is not the result of a happy accident, but of long and persistent endeavor.

There are some investigators whose disposition permits them to follow their aim, inspired by the mere love of the labor and the work. There are others to whom the sunshine of appreciation is necessary. To either class, appreciation, when it comes, is always acceptable; and I assure you that the judgment set upon my investigations by this academy is highly valued by me.

It has been intimated that a short account of my work would be of interest to the members of the academy. My attention was first called to the construction of dividing-engines by an inspection of a dividing-engine constructed by Prof. W. A. Rogers, at Waltham, in this state. On returning to Baltimore, I devoted much time to the general problem of such machines; and, through the liberality of the trustees of the Johns Hopkins university, I was enabled to construct an engine. In about a year this engine was finished. It worked perfectly the moment it was put together, and it has not been touched since. In order to rule diffraction-gratings, I reflected that it was necessary that the screw should be perfect, and that the rests for the plate which receives the ruling should also be as perfectly adjusted as is necessary in optical experiments.

The process of making the screw consisted in grinding it in a long nut in which it was constantly reversed. When this screw was finished, there was not an error of half a wave-length, although the screw was nine inches long.

When the dividing-engine was completed, my mind was occupied with the problem of the best form of surface to receive the ruling. I speedily discovered, that, by ruling the lines on a concave mirror of long focus, I could dispense with a collimator and with the ordinary arrangement of lenses. I now rule gratings six inches long, with various numbers of lines to the inch. I find that there is no especial advantage in having more than fourteen thousand to the inch, with the ordinary conditions of ruling. Having made the concave grating, I invented a simple arrangement for mounting it, so that a photographic camera should move along the arc of a circle at one end of a diameter, upon the other end of which the grating was placed, and always remain in focus. With this apparatus, one can do in an hour what formerly took days. Moreover, the spectra obtained are always normal spectra, and every inch on a photograph represents a certain number of wave-lengths.

After finishing my apparatus, I found it necessary to study photography; and I therefore devoted much time to this subject, and made a special study of all known emulsions. I discovered that an emulsion containing eocene enabled me to photograph from the violet down to the D line; and other emulsions were used for the red rays. I have also been engaged in enlarging my negatives and in printing from these negatives. On these enlarged photographs lines are doubled which have always been supposed to be single. The E line is easily doubled. My map of wave-lengths is based upon Prof. Charles S. Peirce's measurements of the wave-length of a line in the green portion of the spectrum.

At the conclusion of Professor Rowland's remarks, many questions were asked in regard to his beautiful device for photographing the spectrum, and the enlarged photographs which he showed were carefully examined.

PROGRESS OF ELECTRICAL SCIENCE DURING 1883.

THE subject of electrical science has become so broad that he who desires to keep abreast of the line of advance, and also to be on some points in advance of others, must read an immense amount in the English, French, German, and Italian journals, and in the patent-office reports of the various civilized nations. This is generally recognized; and courses in electrical engineering have been established in England, and are about to be established in America. This increase of intelligent appreciation of the magnitude of the subject of electricity is one of the features of the past year.

Perhaps the most important text-book that has appeared during the year is the English translation of Mascart and Joubert's treatise on electricity, with new notes by the authors. Clausius, also, has published a treatise on the theory of the dynamo-electric machine; and there have been numerous articles in various magazines upon the general subject of mathematical electricity.

The electrical congress which met in Paris, October,

1882, discussed the following questions: 1°. A redetermination of the ohm. 2°. (*a*) Atmospheric electricity; (*b*) protection against damage from telegraphic, telephonic, and electric-light wires; (*c*) terrestrial currents on telegraphic wires; (*d*) establishment of an international telemeteorographic line. 3°. Determination of a standard of light.

After a prolonged discussion, it was concluded that further experiments upon the unit of electrical resistance were necessary before a standard ohm could be adopted; and the governments participating in the congress were invited to encourage independent determinations of this unit. The section on earth-currents and lightning-conductors recommended also that the various governments should favor systematic observations, and that independent lines should be provided for the study of earth-currents; that long subterranean telegraphic lines should be used also for this purpose. The section on the standard of light were in favor of employing as a standard the light emitted by a square centimetre of melting platinum. The congress was adjourned to October, 1883; and afterwards the French government notified the various governments participating in the congress, that April, 1884, would be a more agreeable time to the majority of the congress than October. It is probable, therefore, that the congress will re-assemble during the coming spring.

Since the last meeting of the congress, various new determinations of the ohm have been made. E. Dorn, by a modification of Weber's second method, used also by Kohlrausch, has obtained the following value:—

$$1 \text{ S. E.} = 0.9482 \times 10^{10} \frac{m\,m}{\text{sec.}},$$

where S. E. denotes the Siemens or mercury unit. Lord Rayleigh has obtained .986 as the mean of the results of three independent determinations of the British association unit. Professor Rowland is at present engaged upon a careful redetermination of the ohm, using his apparatus for determining the mechanical equivalent of heat as a check upon the electromagnetic methods.

The subject of the cause of electromotive force obtains and deserves attention. Exner has maintained that there is no known case of chemical action without the development of electricity, and also of the development of electricity without chemical action. Braun controverts this conclusion. Exner finds that in a cell with zinc and platinum electrodes, and iodine or bromine as the liquid, a difference of electrical potential is obtained, notwithstanding the fact that iodine and bromine are elements, and cannot, therefore, be electrolytes. Exner believes the cause of this current is to be sought in chemical change. Braun shows that Exner did not take sufficient precautions to insure the purity of the iodine and bromine, and also to prevent the disturbing influence of the aqueous vapor in the air. He shows that there are numerous cases in which we have a development of electricity without chemical action, and also strong chemical action without the development of electricity. It is beginning to be perceived that the subject of thermal chemistry requires also a consideration of electromotive force.

In a voluminous paper containing a large series of observations, Quincke endeavors to verify Maxwell's conclusion that the square root of the dielectric constant must be equal to the index of refraction for light of the same substance. The several methods adopted give results which are not in accordance with Maxwell's theory of light. Quincke explains the different results obtained by different observers, as follows: 1°. Experiments show a fluctuation in the values of the index of refraction which is due to the electric force; 2°. A comparatively long duration of the electric pressure causes a fall in the value of the index of refraction equivalent to the effect of a rise of temperature between 0.0001° and 0.1° C. (this increases with the difference in potential between the electrodes, and can be attributed to internal friction caused by electric attractions and repulsions between the particles of the fluid); 3°. The phenomena of the change of the index of refraction show that the electric pressure has no analogy with hydrostatic pressure; 4°. These changes in the index indicate changes in hydrostatic pressure in the interior of the fluid, which are caused by the electrical pressure, the fluid being set into vertical movements thereby; 5°. The electrical effects appear to be transmitted through the fluid by impulses, and not in a continuous manner.

Julius Elster and Hans Geilel show that Zamboni's dry piles can be used as accumulators. The copper pole of the pile is connected with the positive, and the tin pole with the negative, pole of a Holtz machine. After the latter has been worked for a few minutes, the dry pile is found to be charged. After repeated discharges, the pile is found to contain a charge of considerable intensity. The authors recommend the following form of pile. The plates of the pile are strung, by means of a needle, upon a silk thread, and then stretched between the poles of a Holtz machine. A pile of eleven thousand pairs of plates, of one square centimetre surface, after ten minutes' charging, gave sparks one millimetre long, and made a Geissler tube luminous. The light of the tube was continuous at first, and afterwards intermittent. These piles are well suited to exhibit to a large audience the principle of Planté's or Faure's accumulators.

An interesting report upon the transmission of power by electricity was presented by Cornu to the French academy in April, 1883. This report was that of a commission appointed to examine the experiments of Depretz. It was found that the work absorbed by the generatrix, and transmitted to the receptrix, increases with the velocity of the generatrix. Depretz has succeeded in transmitting nearly four and a half horse-power through a resistance of a hundred and sixty ohms, which represents a double telegraph-line of eight and five-tenths kilometres. The work received was thirty-seven and a half per cent of that spent. With a greater velocity of the generatrix, it seems possible to transmit power to greater distances than Depretz has attained. This

amounts to saying that a high electromotive force is necessary for this end.

Many experiments continue to be made upon the magnetizing-function of steel and nickel. Hugo Meyer has experimented with weak magnetizing-forces, and finds that, 1°, the magnetizing-function has a positive value for a diminishing magnetizing-force; 2°, it increases at first with the magnetizing-force; 3°, it increases, for weak magnetizing-forces, with the temperature. Professor Ewing of Tokio, Japan, maintains that soft iron can be far more retentive of magnetism than steel. His results and detailed experiments are awaited with great interest.

Experiments made in the physical laboratory of Harvard university during the year have shown that the action of magnetism upon the conduction of heat, which has been maintained by several investigators, does not exist in magnetic fields which are at least ten thousand times the strength of the earth's field in Cambridge; and doubts are thrown upon such an action in general.

Hall's phenomenon continues to attract attention. As is well known, Mr. Hall has shown that an electrical current, traversing a thin plate of metal which is placed in a strong magnetic field perpendicular to the lines of magnetic force, has an electromotive force exerted upon it. At first it was supposed that this showed that an electrical current could be affected independently of the medium through which it passes. Mr. Hall, however, showed that the effect was different in different metals, and that the first conclusion was untenable. Aug. Righi has modified Mr. Hall's apparatus, and has discovered that the action in bismuth is extraordinary, being five thousand times as strong as in gold. The effect in bismuth can be obtained with a permanent magnet; and Righi hopes to show the phenomenon by means of so feeble a force as the earth's magnetism.

Edlund has broached a theory that a vacuum conducts electricity, and that the high resistance in rarified tubes is due to a contrary electromotive force at the electrodes in the Geissler tubes. He showed, that, without the employment of electrodes, one can excite an induction current in a Geissler tube which is sufficient to produce light. He maintains that this would be impossible if the highly rarified gas were an insulator.

Among the comparatively new electrical instruments which have been described during the year, are modifications of Lippman's electrometer. This consists, as is well known, of a capillary tube, connecting at one end with a comparatively large receptacle of mercury, and at the other with a vessel containing diluted nitric acid. The superficial tension at the end of the thread of mercury in the capillary tube is changed by a difference of electrical potential. The terminals of a Daniell cell — connected, one with the acid, and the other with mercury — cause a movement in the mercury-column, which gives a standard by which electromotive forces in general can be estimated. The instrument is very sensitive, but requires great care to prevent inaccurate measurements. A. Chevet has devised a modification of Lippman's instrument, which he claims will show a difference of potential of $\frac{1}{1000}$ to $\frac{1}{10000}$ of a Daniell cell. Two flasks, with lateral orifices on the same horizontal line, are connected through these orifices by the tube of a thermometer open at both ends. The bulb-end enters the flask *A*, which is filled with mercury. The capillary end enters the flask *B*. This latter flask is filled partly with mercury, and partly with water acidulated with a tenth part of sulphuric acid. The capillary end of the thermometer enters the acidulated water. A platinum wire, *P*, insulated by a vitreous covering so as not to be in contact with the acidulated water, is in contact with the mercury of flask *B*. Another platinum wire, *N*, is in contact with the mercury of the flask *A*. By means of a commutator a difference of potential can be intercalated between the ends of *P* and *N*. The heights of the mercury and water in the flasks *A* and *B* are such, that, *P* and *N* being connected by a metal wire, the surfaces of separation of the liquids are in the region of the capillary portion of the larger end of the thermometer-tube. The movements of the meniscus is observed with an eye-piece. Electrometers of the class of Lippman's can be constructed by any one at comparatively no expense, and are already used by physiologists. Hard-headed physicists, however, regard such instruments with considerable doubt when quantitative measurements are to be made. The subject of electrometers in general is very important from the point of view of the exigencies of meteorological bureaus and the signal-service. Modifications of Sir William Thomson's instruments still maintain their pre-eminence. Among these modifications is an instrument invented by Edelmann of Munich, in which the box-shaped quadrants of Thomson are replaced by cylinders, and the flat needle also by a suspended cylinder-shaped needle. The writer of this article remembers to have seen, ten years ago, an instrument similar to that of Edelmann, which had been devised by Mr. Moses G. Farmer, formerly of the U. S. torpedo station at Newport. It is said that the insulation of Edelmann's instrument is not perfect.

The cause of the electricity of the atmosphere is still unknown. The experiments of Freeman and Blake have apparently shown that the evaporation of pure water does not produce electricity. Kalischer has lately tested the question whether the condensation of aqueous vapor is a source of electricity. He used a modification of Thomson's electrometer, and connected it, with suitable precautions, with twelve large beakers which were covered with tinfoil and were filled with ice. These beakers, in turn, were protected from extraneous electrical influences. The condensation of aqueous vapor upon the beakers produced no electrical effect which could be observed. The criticism that can be made upon the experiments of Blake and Freeman is, that on the earth's surface an immense evaporation results from salt water, and impurities in the water may produce a state of electrification. Moreover, it is impossible to experiment on evaporation on a sufficiently large scale in a laboratory. An infinitesimal amount of electricity may

be produced by evaporation, which, although too small to be observed, may yet be integrated over the surface of the earth into a large sum.

In looking back over the electrical year, we do not find any great discoveries. We notice, however, great activity in the process of refining old methods. The electrical exhibition at Vienna showed a host of applications of electricity to the arts. There was, however, no striking new invention like the telephone. In all civilized countries, the year has brought forth innumerable modifications of telephones and telephonic apparatus. When it had once been shown that even an imperfect sentence could be transmitted by electricity, the dullest inventor could discover, among the *débris* of his laboratory, magnets and electromagnets which needed but a slight twist here and there to be made into telephones. A touch of genius was necessary for the first twist; and then the whole electrical world had the seed of the invention. It is rumored that long-distance telephoning will soon be attempted with wires of low resistance.

Electric lighting continues to attract great attention; and more correct calculations are daily made, which will soon enable us to judge of the relative economy of incandescent lighting compared with gas. In an address to the Society of arts in London, the lamented Dr. Siemens — whose sudden death last December has been such a loss not only to electrical science, but to science in general — made an elaborate calculation of the cost of lighting large areas in cities, taking the parish of St. James in London as an example and also as a unit. He estimated that to light London to twenty-five per cent of its total lighting-requirements would require an expenditure of capital of fourteen million pounds, without including lamps and fittings; making an average capital expenditure of a hundred thousand pounds per district. Siemens estimated the cost of lighting by incandescence as twenty-one shillings and nine and a half pence per lamp per year; while to produce the same luminous effects in a good Argand burner costs twenty-nine shillings per year. This apparently shows that incandescent lighting is cheaper than lighting by gas, at the present price of gas.

Electric lighting seems to gain in the estimation of the public. Even the argument that if the electric-light companies were compelled to put their wires under ground the companies could not pay their expenses, and consequently that the public would lose the benefits of the electric light, has a strong influence upon many who prefer light to darkness in our city streets. The public, however, are only beginning to realize the dangers from the present method of running electric-light wires. A heavy storm at night might cause at any time disastrous conflagrations, from the electric-light wires coming in contact with other wires and with wood-work. The bulletins published by the Edison electric-light company show the great extension of his system. His plants are to be found in almost every civilized country; and the company are paying great attention to village plants.

The writer of this article is informed that the cost of lighting the great steamboat, The Pilgrim, is not far from that of gas, with a far better quality of light than gas could give. Lighting by incandescence is a great luxury; and, as soon as the public imagination has been sufficiently stimulated, it promises to become a necessity in many quarters. Other systems besides that of Edison are competing for the field opened for enterprise.

The practical applications of the storage of electricity, so called, have not been numerous during the year. It is maintained that it is more economical to use electrical accumulators than to light directly from dynamo-electric machines. There is still a wholesome fear of having several tons of lead left on one's hands in a disintegrated condition. Further experiments are necessary on an extended scale, with especial reference to a large factor of time, before electrical accumulators can be pronounced a practical success.

John Trowbridge.

BIOGRAPHIES OF NATURALISTS.

Heroes of science: botanists, zoölogists, and geologists. By Prof. P. Martin Duncan, F.R.S., F.L.S., etc. (London society for promoting Christian knowledge.) New York, *E. & J. B. Young & Co.* 348 p. 12°.

The plan of the several volumes designated by the common title 'Heroes of science' is worthy of much commendation. It is a frequent and irritating experience of those who have become interested in scientific men's lives to find that they have a scant place in biographical encyclopaedias, and that even the greatest figures in that line of human activity are dismissed with epitaphal brevity of description. The proper way to meet this difficulty would be by preparing an encyclopaedia containing only the names of those who had contributed something to the store of science. 'Heroes of science' has a far simpler aim. Twenty-one names from the great muster-roll of men who may be termed naturalists are all that appear in this book. The first is that of Aristotle; the last, that of Lyell. The aim of the author is clearly to show how these men have played their parts, and something of the way in which they turned the course of science in their time. In this aim it seems to the present writer that Professor Duncan has attained a very substantial success. Within the slender space of two hundred and fifty small pages it is, of course, impossible to do any thing that can be called justice, to more than a score of very notable men, mostly of rich and varied lives; yet the reader will get a sense of their value to the world from the book, that he will not obtain elsewhere. Take, for instance, the life of Lamarck: though all too briefly told for true proportion, it is the best short account of

that true hero that can be accessible to the ordinary reader.

The greatest fault of the book is that the length of the text bears no sort of proportion to the importance of the men or their possible interest to the reader. Lamarck's life is one of the most picturesque of all scientific lives: it is more heroic in quality than that of any other given in the series. Lamarck gave as much or more to natural science than any other naturalist whose name appears here; yet to this man's eventful history but fifteen pages are given, while Sir Roderick Impey Murchison, from whom the world had little profit, who will find his place among naturalists of the second or third order, has twice the space allotted to him. Singularly enough, the one man who should have the first place among the modern men is not named at all. Darwin, who could have claimed a place in all the three divisions of the book as botanist, zoölogist, and geologist, is passed by. It may be that the book was prepared before the death of this great naturalist, and thus that the date does not represent the time of its printing. This is the only possible explanation of this startling omission.

The book is well printed. It has a sufficient table of contents, but no index.

GORDON'S ELECTRICITY AND MAGNETISM.

A physical treatise on electricity and magnetism. By J. E. H. GORDON. Second edition, revised, rearranged, and enlarged, in 2 vols. London, *Sampson Low*, 1883. 343 p., 27 pl., 151 illustr.; 332 p., 46 pl., 161 illustr. 8°.

THE demand for a new edition of a work of this magnitude, within about three years of its first publication, is a sufficient indication of its real usefulness, especially when we consider the fact that the first edition was also republished in this country.

The general scope of this treatise is to detail every thing of importance which is known experimentally respecting electricity and magnetism, referring to, and following as closely as may be, the original memoirs.

The mathematical theory of the subject is omitted so far as possible; nevertheless, the connection between the experimental facts and the results of modern theory are constantly pointed out by very numerous citations and references, especially to Maxwell. Indeed, these may, perhaps, be best regarded as companion volumes to those of Maxwell, from which the reader may learn how far theory and facts are now known to be in accordance.

We feel, however, that the author's reading has been too much confined to what has been published in England, and that he has not gleaned the field with equal diligence elsewhere. For example: we find no notice of the remarkable discovery by E. H. Hall of a new action of the magnet on electrical currents.[1]

The principal enlargements of this new edition are contained in the three chapters, 33, 35, and 36.

Chapter 33 contains an account of the beautiful experiments of Mr. Tribe in determining the variations of potential along the surface of a metallic conductor immersed in a fluid-cell by means of the electrolytic deposit upon the conductor.

Chapter 35 gives an account of the hydrodynamical experiments of Professor Bjerkens, on the apparent attractions and repulsions between bodies which are pulsating or vibrating in a fluid, which attractions are due to the mutual action of the currents set in motion by the pulsations. The importance of these experiments lies in the fact that they afford a possible clew to the nature of the mechanism which transmits electric and magnetic forces through space. In the course of these experiments, Bjerkens succeeded in imitating mechanically most of the ordinary magnetic phenomena, and showed that his field of force was similar to the magnetic field.

Chapter 36 details the subsequent researches of Mr. Stroh, respecting the same phenomena. Mr. Stroh used air instead of water as the medium in which the currents were set in motion. In this medium it was possible to explore the field of force much more completely than in water, and so to arrive at a much more exact knowledge of the facts and their explanation.

The author reserves what he has to say upon the subject of electric lighting for another work, which he has nearly completed, and which is to be specially devoted to that subject.

BASSLER'S WEATHER.

The weather: a practical guide to its changes, showing signal-service system, and how to foretell local weather. By S. S. BASSLER. Cincinnati, *Robert Clarke & Co.*, 1883. 54 p., illustr. 8°.

IN spite of our ten years' familiarity with the weather predictions of the signal-service as published in the newspapers, the general reader has as yet a very slight acquaintance with the principles and methods of weather study. The official circular on the 'Practical use of mete-

[1] *Amer. journ. math.*, ii. No. 3.

orological reports and weather-maps,' published in 1871, to aid in popularizing the work of the signal-service, is not sufficiently detailed, and has never had a great circulation. Another edition of it, with additional illustration and mention of the many facts discovered by studies of the ten years of signal-service observations, is now much needed; for we have no book in this country occupying the place held in England by the excellent little volume on 'Weather-charts and storm-warnings,' prepared by Mr. Scott of the British meteorological office. An attempt in this direction has, however, recently been made by Mr. S. S. Bassler of the Cincinnati *Commercial gazette*, who aims to make "a practical guide to weather-changes, and a help to a better understanding of the weather reports and predictions daily issued," with especial adaptation to the Ohio valley. The ordinary sequence of atmospheric conditions accompanying barometric maxima and minima is briefly described and roughly illustrated; but we regret to find in the field of popular instruction, where conciseness, clearness, and accuracy are of prime importance, so many departures from these essentials. Error and inaccuracy of statement, as well as the omission of many important facts, for which ample space might be found by avoiding needless repetitions, indicate lack of acquaintance with the subject; and although the preface says that "it is not proposed to consider any of the conflicting scientific theories, many of them still mere assumptions that have been accepted as explaining the phenomena daily presented in our atmosphere," we find on p. 36 the following obscure and inaccurate statement concerning the origin of storms: —

> "The warm, light, vaporized air may move high over the land, frequently over strata of dry cool air, in great volume, from the central meteorological zone, gradually sinking down and forming the germs of barometric fields of low pressure, which spread and develop into extensive storm areas. It is in such fields that the heat of the sun is concentrated and storm centres originated. The earth absorbing electricity from the air, electric disturbances of more or less violence, according to the intensity of the condition, are experienced. The absorption or withdrawal of electricity from the vaporized air produces sudden condensation, excessive precipitation, and change of temperature."

It is said farther on, that the tornado "has its origin in the enormous electric tension caused by the friction of opposing atmospheric currents of different temperature; and electricity is undoubtedly the active agent producing the appalling effects of tornadoes." Some physical demonstration of this very popular and very erroneous assumption would not be out of place after so unqualified an assertion. The pamphlet is better than nothing, but it is by no means a satisfactory piece of work.

ART-CATALOGUE OF THE NEW-ENGLAND MANUFACTURERS' INSTITUTE.

Catalogue of the art department of the New-England manufacturers' and mechanics' institute. Boston, *Cupples, Upham, & Co.*, 1883. 4°.

This catalogue certainly has a very alluring exterior, and leaves little to be desired in its general presentation of reproductions of certain sketches and pictures which were exhibited at the fair of 1883 in Boston. It is not our function to criticise the pictures, but the methods of reproducing the pictures and sketches by the various mechanical processes exhibited in the catalogue fall within the province of *Science.*

Still, a critic of the various methods of reproduction of pictures cannot limit himself entirely to a mere consideration of the thoroughness of the technical processes involved in such reproductions; for he would appeal only to the ardent follower of the albertype process, or to an etching process. He must decide as impartially as possible, which of the various methods exhibited, for instance, in this catalogue, gives an idea of the pictures which appeals to the artistic sense in the fullest way. From this point of view there is no doubt that the wood-engravings and the etchings in this catalogue are superior to the specimens of the albertypes, and to those of the photographic processes in general. No photolithographic process represents the values of the lights and shades of a picture except in the most solid and implacable manner. Witness the 'View on the Nile,' which represents a darbeah in the foreground, with some figures on the river-bank near it, a stretch of river and of low-lying hills. The reproduction has an air of *vraisemblance*, but nothing more. It is not artistic. The little picture entitled 'Give me a swing,' representing a pretty little girl leaning against a tree near a hammock, and coquettishly entreating some passer-by, is a better specimen of what an albertype can do. The remaining specimens of albertypes lose whatever clearness of definition a real photograph might possess, and render the blackness of shadow of many photographs in a still more pronounced way; so that the albertypes presented in this volume have the appearance of poor photographs. There are certain subjects, however, for the reproduction of which the albertype is suitable.

'The spring near Orange, N.J.,' for instance, renders the peculiar mistiness and indefiniteness of a New Jersey landscape at that time of the year with considerable truth. The fascination of a new process of reproduction makes one eager to extend it to all subjects; and it is only after a long period of comparison that one can get far enough away from this fascination to obtain clear judgment of the possibilities of the method. He who discovers for himself the possibilities of a pot of red paint in decorative art is at first apt to apply the paint to every thing.

The wood-engraver and the etcher have nothing to fear at present from the various lithographic and photolithographic processes, save in the cheap market. The various gelatine processes must necessarily intensify the want of half-lights which is a characteristic of many photographs, and must obliterate even the faint differences in the degree of darkness of shadows which the original photograph may show.

Heliotypes and similar processes stand in the same relation to the pictures they reproduce that music-boxes stand to the performance by the musician of the piece of music they strive to reproduce. The delicacy and freedom of the original performance is lost. This cannot be said of wood-engraving and etching. The wood-engravings and etchings in this catalogue are superior to the other methods of reproduction, and show a capacity for interpreting the sentiment and the skill of the artist, even to the extent, sometimes, of improving on the originals of which they are the reproductions. The progress of one's art-culture is generally from photographs to engravings, and from engravings to etchings; and a half-hour's study of this illustrated catalogue would hasten one's culture in this generally accepted way.

YARROW'S CHECK-LIST OF AMERICAN REPTILES.

Check-list of North-American Reptilia and Batrachia; with catalogue of specimens in U. S. national museum. By H. C. YARROW, M.D. Washington, *Government*, 1883. (Bull. U.S. nat. mus., 24.) 8 + 249 p. 8°.

IN this catalogue are included the names of three hundred and thirty-seven species and sub-species of reptiles, and one hundred and thirty batrachians, found in North America north of Cape San Lucas and Key West. The trinomial system of expressing the variations of widely distributed and variable species is adopted, as in the recent check-lists of birds; and the sub-species are numbered with the species. Each species and sub-species has been furnished with an 'English' name, although very few of them have any distinctive vernacular appellation in fact. The author observes, that to the task of ascertaining the English names in actual use has been added "the very laborious one of translating as literally as possible some of the polysyllable Greek and Latin names." This, it seems to us, has been a wholly profitless task. It is no gain to any one to call Amblystoma jeffersonianum platineum the 'slender salamander,' while the related Batrachoseps attenuatus is the 'slender lizard.' Nor is it evident why most, but not all, of the species of Plethodon, are called 'lizards,' while those of related genera are chiefly 'tritons' or 'salamanders.' Hemidactylium scutatum, although in no proper sense a lizard, and not scaly, is called the 'scaly lizard,' instead of the 'shielded little half-toe,' as its name would imply. Perhaps these English names of Dr. Yarrow are as good as any other set of made-up vernacular names; but, if so, it is time to protest against the whole business. Scientific names themselves are sufficiently trying without this additional incubus.

The classification and nomenclature of Dr. Yarrow's list is essentially that of the check-list of Professor Cope. Several additions have been made, and a few changes of name; most of the latter being in the group of turtles, and due to the studies of Mr. F. W. True. Some further changes in nomenclature must take place; as the substitution (already suggested by M. Boulenger) of 'Cryptobranchus' for 'Menopoma,' of 'Necturus maculatus' for 'N. lateralis,' and the suppression of the generic name 'Muraenopsis,' pre-occupied among the eels.

After the check-list, follows a list of the specimens of each species in the National museum. This list is of very high importance as a contribution to our exact knowledge of the geographical distribution of species, and is, in fact, the *raison d'être* of the whole memoir. The bulletin is completed with a list of species desired by the museum, and with full index to scientific and vernacular names of species, and to the localities and names of persons mentioned.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Mount Shasta. — In *Science*, No. 48, was mentioned Mr. Gilbert Thompson's suggestion, that Mount Shasta, in northern California, would be a good point upon which to establish a permanent meteorological station like those on the summits of Mount Washington and Pike's Peak. The following notes, obtained from Mr. Thompson, will perhaps make more apparent its suitability for that purpose.

Mount Shasta is a volcanic peak having an altitude of 14,511 feet above sea-level, and situated in latitude 41° 24′ 30″, and longitude 122° 11′ 34″. So prominent is it, that it rivets the attention even at a distance of over a hundred miles; and at Berryvale, where it rises over 11,000 feet in a distance of ten miles, its appearance is majestic. It is not part of a mountain range, and no mountains within a radius of forty miles from it attain the elevation of 9,000 feet. The greatest length of the north-west slope is sixteen miles to the edge of Little Shasta valley, which has an elevation of 3,000 feet. The south-western slope to Elk Flat (where the elevation is 4,000 feet) has a length of eight miles. The highest divide, six miles to the north-west, has an altitude of 6,000 feet; while the divide of the Sacramento River, ten miles to the westward, has an altitude of only 3,500 feet. The distance from the summit in any direction, to the contour of 8,000 feet, will not exceed four miles. The prominence and isolation of this volcanic cone are therefore obvious.

The point at which the growth of timber receives its greatest check is at an elevation of 8,200 feet. This limiting-line is a conspicuous feature in the view of the mountain as seen from a distance of forty or fifty miles, as it contrasts sharply with the snow. The last tree (so small that it was put in the vest-pocket) was found at 10,130 feet.

The streams that have their origin in the melting of the snows of Mount Shasta make their appearance suddenly as rushing torrents, which subside during the night, leaving only pools of clear water, which also gradually disappear. On the east side they have eroded deep cañons, in two of which are waterfalls 400 feet in height. After the first snow, the flow of water from the mountain ceases until the following spring. Only two streams can be considered as permanent. There are but few springs; as all this water sinks near the base of the peak, to re-appear at distant places in an unexpected manner as springs of immense size. The hot sulphur-springs, or solfataras as perhaps they should properly be termed, which are now in active operation at the summit of the peak, once extended considerably farther to the south-east. An additional spring was discovered last summer, under the summit to the eastward. The myth of the Win-tún Indians, that Mount Shasta is the assembly-house of the gods, probably had its origin in the existence of these springs. The more prosaic imagination of the topographer suggests that the steam from these vents might be utilized to heat a station built on the summit of the mountain.

Topographic work in the southern Appalachians. — Party No. 2 of the southern Appalachian division, Morris Bien in charge, was engaged during the past season in the north-eastern part of Tennessee, the north-western part of North Carolina, south-western Virginia, and southern West Virginia, — an area of about six thousand square miles, lying between parallels 36° and 37° 30′, and meridians 81° and 83° 30′.

The topography of this area is of the same character as that found by party No. 3 in the Tennessee valley; except, that, in the portion lying in North Carolina, the character of the former is combined with a system of spurs radiating from a sort of central knot, — a feature reminding one somewhat of the Rocky Mountains. This similarity to western topography increases as we go southward on the eastern side of the range, until, in the Black Mountains, it becomes very marked. Another striking difference is, that here there is no apparent underground drainage of the sink-hole nature. In south-western Virginia, however, the drainage is similar to that of the Tennessee valley, and quite as striking.

A curious example of the sinking and re-appearing of streams is found in Scott county, Va. There is a completely enclosed basin in which a considerable creek gathers, and flows toward the Clinch River, from which it is separated by a continuous ridge about three hundred feet high. At the foot of this ridge the stream disappears, and, as has been proved by marked slabs, flows beneath the ridge and under the river, appearing as a spring about half a mile from the river, and on the opposite side of it. The underground course of the stream must be somewhat like an inverted siphon. The sink of the creek is about twenty feet higher than the river, and nearly the same height above its outlet at the spring.

In the same county is the natural tunnel of Stock Creek. At about eight miles from its head, the ravine in which Stock Creek flows is closed in by a distinct cross-ridge about four hundred and fifty feet high. The creek, which is about fifteen feet wide and three feet deep, has made an S-shaped tunnel through the ridge about nine hundred feet long, and averaging fifty feet in width. It is nowhere less than ten feet high, rising at the entrance and outlet to over sixty feet.

The entrance is an almost perfect archway in a perpendicular rock wall which is nearly four hundred feet high, while the outlet is in a remarkable perfectly dome-shaped rotunda of which about half is wanting. The highest point of the dome is about four hundred and fifty feet above the creek-bed. Curiously enough, when visited last September, the creek sank entirely at the entrance, and re-appeared only at the outlet, not a drop of water being visible in the tunnel; whereas during high water a roaring torrent rushes through it. A preliminary line of the South Atlantic and Ohio railroad has been located in the

tunnel; and they propose to make a secondary tunnel, cutting an angle of the S in the natural tunnel.

There are enormous quantities of marketable timber throughout this whole section; cherry, walnut, oak, chestnut, poplar, hickory, etc., growing everywhere. In the extreme south-west of Virginia, fine large poplars are found in great abundance. In Shady Valley, Tenn., is an extensive forest of several thousand acres, in which are to be found most magnificent pines, straight as an arrow, and many over a hundred and fifty feet high.

The mineral wealth of the country has just begun to receive proper attention. Within the past few years the well-known Cranberry iron-mines have been opened, the ore from which is of very fine quality; and it is claimed that the same body can be traced, almost continuously, far north into Virginia. There are several copper-mines in the north-western part of North Carolina which await only the influx of capital to produce in large quantities. Gold has also been found in this section in small amount.

Throughout that part of south-western Virginia lying north-west of Clinch Mountains, coal is found in almost every ridge, and, at Pocahontas, is mined in large quantities. Copper and iron have also been found scattered throughout this section. This region needs only railroad facilities to become one of the richest districts in the east. It can supply coal and timber in enormous quantities; and, from all accounts, iron and copper mining would also be profitable.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Franklin institute, Philadelphia.

Feb. 20. — Mr. S. Lloyd Wiegand presented a further communication respecting the use of cast-iron in the construction of steam-boilers; illustrating his remarks by bursting, under hydrostatic pressure, a model of the exploded Gaffney boiler, which had been the cause of a protracted legal controversy in Philadelphia. Mr. Wiegand protested against the sweeping condemnation of cast-iron as a material for steam-boiler heads, and especially deprecated the effort that had been made to commit the institute as a scientific body, to suit an expression of opinion without experimental verification. On Mr. Washington Jones's motion, a resolution was adopted, in which the national Congress is urged to appoint a commission of experts for the testing of iron, steel, and other materials used for structural purposes, and to make a suitable appropriation for the work of the commission. —— Mr. David Cooper exhibited a remarkably fine suite of specimens of direct life-size camera portraits, admirably illustrating the progress which has lately been made in dry-plate photography. These pictures were taken with dry plates prepared by the Eastwick dry-plate company of New York.

Canadian institute, Toronto.

Feb. 16. — Prof. J. Playfair McMurrich read a paper on the osteology of Amiurus catus, one of a series on the morphology and development of that fish. The paper treated particularly of the high specialization of Amiurus, as instanced by the small amount of cartilage in the skull, and by the great modification of the maxillae and of the pectoral and dorsal fins.

Princeton science club.

Feb. 14. — Professor George Macloskie reported his researches on the tracheal organs of insects, by which it appears that their spiral filaments are not independent structures, but crenulations or inward foldings, with thickening of the chitinous wall; that the spirals are really tubular, fissured at the line of infolding, and continuous with the enclosing wall. The function of aeration is discharged by air passing, not through the wall into the blood, but directly to the tissues by lung-like terminal cells, long ago described by Louis Agassiz, and shown by Max Schultze to be especially abundant near the luminous organs of the glow-worm.

Prof. H. F. Osborn reported, that in the opossum, unlike the kangaroos, the superior and inferior mesenteric arteries and coeliac axis arise from a common trunk above the renal arteries, — a reduction similar to that found in the monotremes.

Prof. W. B. Scott stated that the hind-foot of the American miocene Enteledon shows, like the European, the third and fourth metatarsals greatly enlarged, the second and eighth very rudimentary. The third is borne entirely by the external cuneiform; the middle cuneiform is very small, and coalesced with the external cuneiform; and the internal is very narrow, and articulates above with the navicular, and below with a hook-like process of the third metatarsal. The rudimentary second metatarsal is wedged in between the middle and internal cuneiforms. This type of foot corresponds to Kovalevsky's 'inadaptive type of reduction,' nearly half of the bearing-surface of the tarsus being unemployed.

Dr. McCay called the attention of the club to a letter in the last number of the *Jahrbuch für mineralogie*, from Professor Sandberger of Würzburg. In a pamphlet which appeared recently in Germany, McCay had attacked Sandberger respecting his alleged discovery of the rhombic modification of speiskobalt. McCay has proven that the honor of the discovery is due to Breithaupt of Freiberg; and Sandberger, convinced by the ample evidence, has in his letter admitted the correctness of the arguments advanced, and signified his readiness to withdraw his name 'spathiopyrite,' and to substitute in its place the Breithaupt term, 'safflorite.' Dr. McCay further reported upon eight analyses of argillaceous limestones, several of which seemed admirably fitted for making hydraulic cement.

Prof. C. G. Rockwood and Mr. Fine gave synthetic

demonstrations of the formula for the prismatoid, one section being made at will. —— Mr. Smith gave a new and simple demonstration of the ellipse of stress. —— Mr. Magie gave a proof for the movement of liquids in capillary tubes, both cylindrical and conical. —— Mr. M. McNeill gave a method for reducing to the mean time of observation a series of micrometer measures of distance and position angle, when one of the objects has such a large proper motion that these quantities do not vary proportionally with the time.

Society of arts, Massachusetts institute of technology.

Jan. 24. — Capt. D. A. Lyle, U.S.A., read a paper on the rise, progress, and methods of the U. S. life-saving service. The first organized attempt at saving life imperilled by wreckage was inaugurated by the Massachusetts humane society in 1782, but the true inception of the U. S. service was in 1848; and since that time, in spite of reverses, inadequate appropriations, etc., the service has steadily advanced in efficiency. It was established on its present enlarged basis in 1878, after several years of struggle. At present the whole number of stations is 189, of which 139 are on the Atlantic coast. The following statistics for the year ending June 30, 1882, will show the efficiency of the service: disasters, 345; property involved, $4,766,000; property saved, $3,106,000; persons involved, 2,398, of whom all but 12 were saved; total expense, $594,889.74, or at the rate of less than $250 per person, without considering the value of property saved. During the more inclement months, dangerous shores are constantly patroled; and upon discovering a wreck, a projectile is fired over the vessel, carrying a line, by means of which the sailors draw out a cable, which they secure to the mast, and on which a life-car or a breeches-buoy is run back and forth, by which those on board are carried to the shore. Capt. Lyle explained all the details of the methods used, by means of a model. —— Mr. N. M. Lowe exhibited a model showing a method of transmitting power by belting, designed to replace the ordinary fast and loose pulley.

Academy of natural sciences, Philadelphia.

Jan. 15. — Prof. H. C. Lewis exhibited a specimen of limestone from Utah which emitted a lurid red light when struck, scratched, or heated. The glow lasted from half a second, when lightly struck, to a much longer time as the result of a blow. On examination, the specimen proved to be an almost perfectly pure carbonate of lime, with but a slight percentage of impurities. It is loose-grained, white, and crystalline, the grains being but slightly coherent, thus giving the rock the appearance of a soft sandstone. It crumbles easily between the fingers, forming a coarse sand. When heated in a glass tube over a flame, it glows with a deep red light, which lasts for a minute or more after withdrawing the flame. After two or three heatings the phosphorescent property disappears. A search through the collection of the academy for limestones having similar properties resulted in finding specimens from Kaghberry, India, which glowed with a strong yellow phosphorescence when heated, although no such effect was produced by scratching or striking. It was of great interest to find that the Indian limestone alone, of all in the collection, had the precise external characters of that from Utah. This similarity is more than a coincidence. It confirms Becquerel's view that phosphorescence depends upon physical rather than chemical conditions. In the rocks referred to, it is probably dependent upon a disturbance of their loosely aggregated crystalline particles, whether such be produced by percussion, friction, heat, or decrepitation.

Dr. J. Leidy communicated the results of a recent trip made to Atlantic City for the purpose of collecting and studying some of the life-forms thrown up on the beach by the storm of Jan. 8. The shore at the highest line reached by the tide was for miles covered with millions of bushels of the common beach-clam, Mactra solidissima. In many places they were closely packed together in extensive patches. Besides those visible, it is probable that at least as many more were covered by the sand thrown up at the same time, or had buried themselves in the beach. Until this evidence of the storm he had no suspicion that the mollusk was so exceedingly abundant on the coast; though he had been well aware that it was very common, having repeatedly seen large quantities thrown on shore under similar circumstances. With the Mactra were other mollusks, which, although numerous enough, appeared to be few, compared to the former. These were Fulgur carica, and F. canaliculata, Natica heros, N. duplicata, and N. obsoleta. Hermit crabs were also abundant, — Eupagurus pollicaris in the shells of Natica and Fulgur, and E. longicarpus in shells of Natica. Spider-crabs were common, and a few half-grown horseshoe-crabs were also observed. Some bunches of the common edible mussels were collected.

It seemed remarkable, on the other hand, that some of the commonest mollusks were conspicuous by their absence; few or no oysters, clams (Venus mercenaria), squirt-clams, or horse-mussels, having been seen. Scarcely any traces of annelids were observed, except masses of dead Serpula. There were also no echinoderms, except one, Caudina arenata, which occurred at some places in considerable numbers. It was believed that this was the first time the animal had been observed on the coast of New Jersey. They usually range from three to four inches in length, but several were found upward of six inches, and over an inch in diameter at the thicker portion of the body. They present but little resemblance to the forms commonly recognized as echinoderms or sea-urchins, looking much like large fleshy worms. Dissection, however, at once reveals their true relationship.

It is an interesting question as to what becomes of the vast quantity of Mactra and other shells incessantly cast on shore. Storms annually oblige the ocean to contribute, from its inexhaustible stores, multitudes of mollusks and other animals to the sandy beach. By exposure to the influence of the weather, the air, the sun, the rain, frosts, and other destructive influences, the calcareous shells are broken

and decomposed, and in a comparatively few years entirely disappear. Carbonic acid of the rain-water must be a potent agent in their ultimate solution, as it percolates through the sand. While the beach receives its constant supplies of shells, no trace of these is to be found in the sand immediately back of the shore, which in former times received the same incessant contributions. For similar reasons, no doubt, calcareous fossils are comparatively rare in sandstones, though in many cases their impressions are well preserved.

NOTES AND NEWS.

LUDWIG LIEBRECHT of Lippstadt, in Westphalia, is endeavoring to obtain subscriptions from all countries to establish a memorial in honor of the late Dr. Hermann Müller, whose biography was briefly given in No. 36 of *Science*. The income is to be applied to the support of his family during the life of his widow, and thereafter to aid students of the natural sciences educated at the public school of Lippstadt.

— Professor John LeConte has contributed a series of physical studies of Lake Tahoe to the recent numbers of the *Overland monthly* (San Francisco), in which he sums up what is known of the lake, and suggests lines of work for studious observers to follow. The greatest depth sounded was sixteen hundred and forty-five feet, and the lowest temperature found was at the bottom, 39°.2 F. Like most deep lakes, this one does not freeze, because the winters are not long or strong enough to reduce its entire volume to a cold below this temperature of maximum density. The transparency and color of the water are discussed at length, and an abstract of the recent Swiss studies of lake-oscillations, or *seiches*, is given; as there is every reason to suppose they must occur in our lakes, although not yet recognized here. According to the most reasonable estimates of mean depth, the duration of the longitudinal *seiche* of Lake Tahoe, calculated by Forel's formula, would be eighteen or nineteen minutes; and of the transverse, about thirteen minutes. The lake-basin is regarded as a 'plication hollow' or trough produced between two adjacent and parallel mountain ranges.

— E. and F. N. Spon announce as in preparation 'A history of electricity and of the electric telegraph,' by J. J. Fahie.

— Messrs. Barry, an old wine and coffee firm of London, have since the middle of the last century kept a scale for the amusement of their customers. The results of the weighings have been regularly entered in books kept for the purpose, together with the ages and any remarks called for by the clothing or other condition of the person weighed. Francis Galton, in his search for statistical information of the progress of man, has examined these records, and published a notice of the results in *Nature* for Jan. 17. The weights of the nobility he especially studied, and they show that the variation in weight of this class during the year has steadily declined in the past hundred years from seven to five pounds. Not only is there this evidence of a more regular and healthy life, but the age of greatest weight, which, with the generation from 1740 to 1769, was reached at forty-five, being at that age about sixteen pounds more than the weight of the 1800–1829 generation at the same age. While from that age the entire generation declined in weight, the tables show that the English nobility born in the early part of this century continued to increase in weight till at least their seventieth year; at their sixty-second year reaching that of their grandparents of the same age, who had been growing lighter for nearly twenty years, the later generation rising in weight at almost the same rate at which the earlier declined. The men of the last century seemed to grow stout in early manhood, then to fall off, while those of the present increase steadily with their age.

— Prof. G. Seguenza continues his studies of the quaternary formation of Rizzolo. His last contribution is devoted to the Ostracoda, and comprises about thirty-two pages quarto, with an excellent plate. About thirty-five species are mentioned, and more are to follow. Ten species are well figured. These often elegantly ornamented little creatures have an enormous range; some of these Sicilian fossils being common to Norway, New Zealand, and Sicily, either living or fossil. A number of new species are described.

— Late signatures of the Proceedings of the U. S. national museum contain a catalogue of mollusca and echinodermata dredged on the coast of Labrador by the expedition under the direction of Mr. W. A. Stearns in 1882. This list, which is carefully annotated, covers eleven pages, is illustrated by a plate, and is more complete than any thing hitherto published. It is due to Miss Katherine J. Bush of New Haven. This, and another paper by Rosa Smith in the same issue, would seem to indicate, that at last, if somewhat tardily, women are about to claim their share of work and honors by serious zoölogical investigations.

— Herr R. J. Runeberg, who has been examining the Angara River between Yeniseisk and Irkutsk at the request of Sibiriakoff, has returned to St. Petersburg. He reports that the rapids which obstruct navigation on the upper part of the Angara may be easily removed so as to admit of regular traffic on this important Siberian waterway.

— In a lecture by the Russian academician, Fr. Schmidt, on the Vega voyage, the author sees strong reasons for doubting the sanguine view of Nordenskiöld, that commerce may generally or even frequently find a waterway along the coasts of the Siberian Sea. He recalls, among other evidence, the experience of Rakhmanin, who wintered twice at Spitzbergen, and not less than twenty-six times in Novaia Zemlaia, and who found the way to the Yenisei open on only five occasions.

— A society of natural history has been organized at Sedalia, Mo.; and an address by F. A. Sampson, indicating the objects specially in view, was printed in the Sedalia *Daily democrat* of Feb. 13.

—In 1835 the British House of Commons ordered an inquiry for the purpose of ascertaining "the best means of extending a knowledge of the arts and of the principles of design among the people, especially the manufacturing population of the country." The immediate outcome of the inquiry was a school of design, which began its existence in June, 1837, with an appropriation of fifteen hundred pounds. From this has developed 'The science and art department,' which was formally created in 1856, and has now under its control some twelve different institutions, of which the most noted are the South Kensington museum, the National art training school (transferred to South Kensington in 1856–57), and the Normal school of science and royal school of mines (re-organized as one institution in 1881). In addition to these schools, museums, etc., the department maintains a system of instruction in science and art that extends over the United Kingdom, and in 1882 embraced 977,797 pupils, of whom 68,581 attended science schools and classes, and 909,216 received instruction in art. These numbers do not include the attendants upon the lectures given under the auspices of the department, amounting, during the year, to 8,288.

The appropriation for the year ending March 31, 1883, was £351,400, while the department disbursed during the same time £345,363 14*s.* 7*d.* The grants for building are not included in these estimates, as they pass through Her Majesty's office of works. It will readily be seen that the scheme of instruction and examination maintained by the department has a powerful effect upon the development of science, pure and applied. While it was the only important agent concerned in the work, its dicta passed without opposition: now that other institutions have taken up the service, particularly the City and guilds of London institute, the methods of the department are closely scrutinized, and not a little adverse criticism is heard. On account of the system of examinations and grants, elementary teachers are particularly watchful; and this year they have been very pronounced in their complaints. It is urged by them that the papers set for elementary pupils are impracticable and unfair, betraying total ignorance of the capacity and condition of the class of pupils to be tested. As a result of the wide-spread dissatisfaction, a union of teachers of science and art was effected last June, whose objects are, 1°, the advancement of the profession; 2°, the redress of grievances.

The presidency of this association for a year has been accepted by Professor Huxley, who, perhaps, of all English scientific men, is best fitted to give counsel on the educational aspects. As science examiner and president of the Normal school of science and royal school of mines, Professor Huxley has every advantage for understanding the aims and motives of the department; while his relations with the City and guilds institute and with the Royal society, of which he is president, preclude the possibility of narrow views.

Nothing is more freely conceded in England at this time than the importance of sound instruction in science. The efforts recently made, through the Royal commission, to ascertain the provision for this work upon the continent, have been noted in this country. It is not, perhaps, so generally known, that the English authorities attach great importance to what we are accomplishing in the same direction. It has been repeatedly stated that America surpasses England in this respect. In a public address last November, Dr. Kerr, her Majesty's senior inspector of schools, after an account of the leading institutions of Germany which he had just visited, added, that he believed the finest science school of the world was at St. Louis, America. In his address, Dec. 10, on the occasion of the distribution of prizes to the students of Finsbury technical college, Professor Huxley called attention to the fact that on the American side of the Atlantic there was a people of the same stock, blood, race, and power, as the English, who would run them harder than any competitors had hitherto done.

We were indeed earlier than the English in making provision for the new demands in modern education. The Rensselaer polytechnic school dates back eleven years from the House of Commons' inquiry; and out of eighty-six schools of science, tabulated in the last report of the commissioner of education, twenty-two were organized prior to 1862, the date of the much-abused land-grant. The state appropriations to these institutions for the year are estimated at $298,919, a small proportion of their total expense. The lecture-system maintained by the British department of science and art is a feature that may be studied with profit in this country.

— The subject of the preparation of catalogues of the meteorological literature of different countries was discussed by the meteorological congress of Rome in 1879, and has been repeatedly considered in the sessions of the international committee. At the last meeting, held in Copenhagen in 1882, it was decided that "the prospects of the preparation of a general catalogue of meteorological bibliography were not favorable to its execution, and that the only action for the committee to take was to invite the heads of the different institutes to prepare catalogues of the meteorological literature of their respective countries." The first publication to appear, in accordance with this decision, is the work of Dr. Hellmann. This deserves more than a passing notice, on account of its special merit, as well as the peculiar characteristics which make it much more than a simple catalogue of scientific papers and observations. It is limited to the country of Germany, and treats of the work of the Germans in meteorology from the earliest times to the year 1881. The greater part, containing seven hundred and forty-four pages, is devoted to a list of the scientific papers, arranged, first, according to authors and institutions, and, second, according to subjects. In the former division, which includes the names of about thirty-four hundred persons and eighty-three hundred memoirs, a valuable characteristic is the condensed biographical sketch of each author, usually but a few lines in length. The latter division is of special value to those who wish to know what has been done in special subjects of investigation.

The second part, of a hundred and twenty-three pages, is devoted to meteorological observations, and contains indices arranged according to stations, countries, and observers. The third part is historical, and contains an outline of the history of meteorological observations in Germany to the present time, followed by chronological and statistical tables.

It need not be said that the work of Dr. Hellmann is of great value, and will be a useful work of reference for students. It is somewhat of a disappointment, however, to find that the work is strictly confined to Germany and German authors, instead of including all meteorological writers who make use of the German language. On account of this limitation, Austria is not represented, though the part borne by that country in meteorological work of a high order is to-day so prominent. A similar catalogue for the latter country is needed to supplement the work of Hellmann.

— The New Hebrides, discovered by Quiros, and explored by Bougainville and by Cook, remained neglected until the failure of sandal-wood in China; and the need of laborers in the cotton plantations of Australia and Fiji, brought them again into notice. Mr. Roberjot relates, in the *Bulletin* of the French geographical society, the story of a visit to these islands in the French vessel le Segond. Of the natives of Tanna the writer says, 'As were the natives of this island in the days of Forster and Cook, such are they to-day.' Their dress is a cincture only, arranged in clumsy fashion. On the island of Sandwich is a novel fashion of exhibiting wealth. The houses in a palisade face the centre of the space, which is ornamented with posts, whereon hang dried hogs' jaws. Now, as wealth there consists in the abundance of swine, there is some vanity in showing how many one has eaten. The houses on this island are much better than those on the neighboring islands. Moreover, a certain number of constructions appear to serve the purpose of meetings or of storing provisions. A little distance from the houses were many trunks of trees planted in the earth. Each one of them has at its upper extremity two holes communicating, and their surfaces are ornamented with carved devices. Each of these trunks is a veritable instrument, and their union forms an orchestra. The report of Mr. Roberjot is full of interesting information, and several short vocabularies are given.

— Dr. Daniel G. Brinton has published, in the *Folk-lore journal* for August last, a paper on the folk-lore of Yucatan, founded on unpublished material which has fallen into his hands. A very interesting fact brought out by the author is the curious mixture of the old paganism with christianity. In the language of Garcia, with reference to the conversion of the natives, 'the only difference was, that the natives were changed from pagan idolaters to christian idolaters.' The ancient imposing rituals have passed away; but the belief in sorcerers, witchcraft, and magic is as strong as it ever was. These wise men divine with a rock-crystal, and have great influence over growing crops. The four cardinal points are named after the sacred four (*pah-ah-tun*) of the ancient religion, and also after four saints of the catholic calendar. These points of the compass are also the seats of the winds, and are denoted by separate colors. There still continue to be relics of an ancient form of fire-worship. Another of the modern ceremonies which is imbued with the notions common to primitive peoples is the 'feast of the food of the soul.' Along with these there are many minor superstitions connected with the growth of crops and fruits. Men and women are alike possessed of this magical power, which fact is confirmed by a witch-story recited by Berendt.

To the Maya, the woods, the air, and the darkness are filled with mysterious beings, who are ever ready to do him injury or service. Among these beings, the most familiar friendly spirits are the *Balams*. They are great smokers, and the shooting-stars are supposed to be huge cigar-stumps thrown by them down the sky. Another spirit is *Che Vinic*, 'the man of the woods,' a huge fellow without bones. Another ugly customer is *Culcalkin*, 'the priest without a neck.' There are also dwarfs and imps to worry the poor Maya, the most common among whom are the *H'lox*, 'the strong clay images;' the *Chan Pal*, 'little boy;' the *X'bolon thoroch*, 'the feminine imp who magnifies the sound of the spindle;' *X tabai*, 'the (female) deceiver;' and *X Thoh Chaltun*, 'Miss Pound-the-stones.' Many superstitions cling around the animal world also, and the sorcerers often claim the power of changing themselves into some animal.

— The project of cutting the Perekop Isthmus, which unites the Krimea to the mainland, has been approved, and the chief question now under discussion is the best manner of obtaining the necessary funds for carrying on the work.

— The extensive collection of mammals obtained by Mr. J. C. Zeledon in Costa Rica has been forwarded to Messrs. Godman and Salvin in London, to be used in their work upon the *Biologia Centrali-Americani*.

— The treaty for settling the Russo-Persian frontier has been decided upon, and the work of settling certain doubtful points in regard to the boundary has been going on during the past season. The treaty recognizes Merv as Russian, and Kelati and Udiré as Persian territory, but remains subject to modification in minor details consequent upon the surveys now in progress.

— The nematods, trematods, and acanthocephali collected by Fedtschenko in Turkestan have been worked up by von Linstow. There were a hundred and nineteen alcoholic and forty-five microscopic preparations, representing ninety-seven species, of which thirty-six were new. There was one new genus, Aprocta. Forty-seven species are known from other parts of the world, five being cosmopolitan, and fourteen known in America, Europe, and Asia. Of these last, eleven infest man or domestic animals: hence their distribution is probably artificial. With our present imperfect knowledge, it is impossible to study the geographical distribution of helminths.

SCIENCE.

FRIDAY, MARCH 7, 1884.

COMMENT AND CRITICISM.

In the rapid progress which animal morphology has been making in this country during the past few years, we doubt whether the vertebrates have had their due share of attention. With the exception of Cornell, we believe that the larger laboratories are turning their students principally to investigation among the invertebrates, — among this class, Cambridge and Baltimore. We do not for a moment under-estimate the immense value of this work, or the high standard it has attained; but are we not slighting the rare opportunities the United States afford for vertebrate research, and allowing it to be done by foreigners? To illustrate by a few examples out of many. In embryology the alligator and the urodele amphibia present the most important field of work. As regards the former, Professor Kitchen Parker of London has just completed a monograph upon the development of the skull, principally based upon American material. As regards the latter, is it not surprising, that, with an abundance of living specimens at ready command, the best work upon the angiology of the group is coming from Boas in Denmark; and upon the anatomy and embryology, from Wiedersheim and others in German laboratories; while here we have only to show a few current researches upon the neurology? Our large avian fauna invites the kind of systematic anatomical work which the late W. A. Forbes, and his predecessor as prosector, A. H. Garrod, undertook in the London zoölogical gardens. But there is another quarter where the harvest is still greater and the laborers fewer; that is, vertebrate paleontology. We can count upon the fingers of one hand the investigators in this magnificent field; yet there is enough work for several lifetimes in the fossils already exhumed, without mention of those which lie waiting the collecting-sack of the explorer.

However just "Professor Rowland's vigorous denunciation of American science text-books" may be in respect to the sciences with which he is conversant, it need not be forgotten that in at least three departments of natural history this country has been seasonably provided, by its most competent hands, with text-books, which, for their purpose and scope, have not been surpassed in any other part of the world. It is a remarkable fact that two of them, Dana's Mineralogy and his Geology, are from the same hand.

The suggestions regarding the preservation of our few important aboriginal monuments, made by the curator of the Peabody museum to its trustees at their recent annual meeting, is one that should excite general interest and attention. These monuments are fast disappearing under the plough and harrow, and many are further endangered by the growth of population in their neighborhood. As a rule, the land about them could be purchased of their present owners for comparatively small sums; and trusty keepers could be installed at no expense beyond the free lease of the reserves, with liberty to till such outlying portions as could do no harm to the monuments.

It would be eminently proper for the states in which these monuments exist to take efficient action for the preservation of the most important; but, if the states are likely to delay in the movement, the townships or local societies should at once secure the works from further destruction. These failing in immediate action, why cannot an association be formed for the purchase and care of ancient monuments; the association to hold them, until, by legislative action, each state shall take those within its borders under perpetual care? or perhaps it would prove the speediest and most satisfactory method of all, if persons specially interested in the preservation of certain of them

would combine to purchase the sites, and transfer the custody of the same to the trustees of the Peabody museum at Cambridge, which, as the only institution in the country specially devoted to American archeology, would be a fitting and safe almoner of such a trust.

A FEW months ago a piece of vandalism which shocked the scientific and artistic worlds was perpetrated in Munich. Some fiend took it into his head to disfigure the beautiful new marble statue of Liebig by staining it with a dark liquid. It was at first thought that it would be impossible to remove the stains, as they were found to have affected the marble to some depth beneath the surface. A commission of chemists, consisting of Professors von Pettenkopper and Baeyer, Liebig's successor, and Dr. Zimmermann, was appointed to investigate the matter, with a view to determine the nature of the stains, and to remove them if possible. It was found that nitrate of silver had been used, with which some permanganate of potassium had probably been mixed. It is gratifying to learn that the work of the commission has been entirely successful, the stains having been completely removed without injury of any kind to the statue. The method used consisted in transforming the metals, silver and manganese, into the sulphides by treating the spots with sulphide of ammonium, and then with cyanide of potassium. The chemicals were used in the form of pastes, made by mixing them with finely-powdered porcelain-clay.

GEN. TENNANT has recently called attention to a possible cause of variation in the rates of chronometers, which has never before been considered; namely, the humidity of the air. The subject is well worthy of investigation; and it is to be hoped that those interested in determining the rates of chronometers will also make observations on the humidity of the air around the chronometer, in order to determine whether any such effect is really produced. Gen. Tennant's results are not presented in such a form that a positive conclusion can be reached.

THE appointment of Professor Flower to succeed Sir Richard Owen as superintendent of the natural-history department of the British museum is as gratifying to American naturalists as it is to the majority of those in England. The removal of this section of the museum to the new building, South Kensington, will, of course, sever it still further from the control of the chief librarian, who is technically the head of the entire organization; while the new policy of making it an educational museum, as well as a museum of research and record, adds much to the responsibilities of its officers. Professor Owen, having brought his career as an active investigator to a wonderfully satisfactory conclusion, is glad to be relieved of administrative duties, and to retire to his country home near Richmond, to devote his few remaining years to quiet study. Professor Flower, who succeeded him as conservator of the museum of the Royal college of surgeons, has demonstrated in that capacity his ability as a museum director. His work as an investigator has been extensive and important; and there is no naturalist in England who is more deservedly popular, or who could command a more unanimous support among his fellow-workers. Seconded, as he is, by three such experienced assistants, — Dr. Gunther, keeper of the zoölogical collections; Dr. Woodward, keeper of the geological collections; and Dr. Carruthers, keeper of the botanical collections, — there can be no doubt that Professor Flower will be able to add very much to the efficiency of what is already the most extensive natural-history museum in existence.

WE referred, a few weeks since, to the favorable opportunity now afforded for observations upon Saturn. At the January meeting of the Royal astronomical society of London, there was an interesting discussion upon the markings upon the planet observed by Mr. Pratt of Brighton, and other members of the society. The planet was described as having on each side of its equator a zone of creamy tint, unusually free from markings. At about latitude 10° south, there was a strong narrow belt sharp-

ly defined on its equatorial side, diffused upon its polar side, and gathered in places into wispy notches and curved markings. The color was a vandyke brown. Several other belts of different tints were interposed between this one and the pole. Other observers mention the existence of loops somewhat resembling the markings on Jupiter. The planet is now too far past its opposition to be well observed during the present season; but the opposition of December next will be yet more favorable for observations, and will, we hope, be taken advantage of by all possessors of telescopes.

LETTERS TO THE EDITOR.

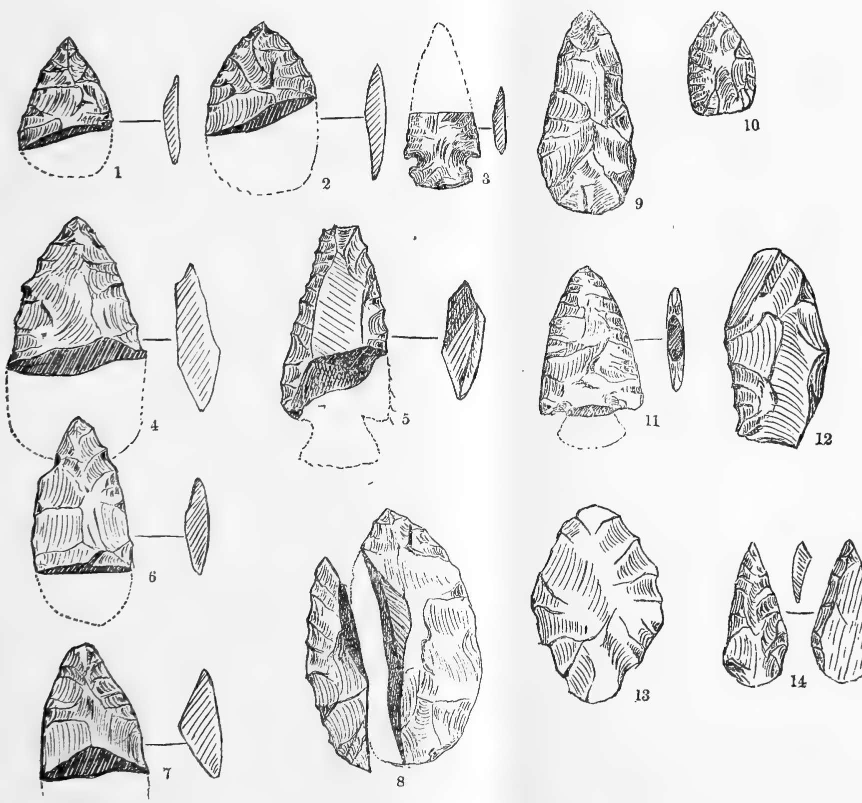
*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Arrow-points at Evanston, Ill.

In the sand-ridge at Evanston, just back from the beach, and which follows the shore more or less continuously for a number of miles south, there are exposed intervals where the frequent violence of the lake-winds does not permit the usual growth of vegetation. These places are often scattered with flint-chippings for an area of several square yards, marking spots where formerly stone implements were chipped. The very fresh appearance of the chippings upon the surface at this remote day, as if just dropped there, is accounted for by the sweeping of the wind from the exposed quarter over such localities, winnowing the particles of sand from the heavier flint. The chippings scattered in the light soil around the operator, while he fashioned the implements, remain at the original site; but, as the sand is gradually blown away, they appear at a lower level than before, and strewed over the hard, smooth surface which the wind has left.

In protected places, on the other hand, where the blowing sand accumulates in drifts, chippings, instead of being exposed, have been covered to a considerable depth, as excavations in the vicinity often show.

The mineral used was in all cases a reddish chert of various shades, found abundantly in the shape of rounded stones upon the beach. The chippings are irregular flakes, amounting in certain localities to what might readily fill a bushel basket; and search nearly always reveals some broken and unfinished arrow-points of the same mineral. The successive stages occur, from the rough chert flake to the completed implement; the most common being simply a half-arrow point, presenting a fracture across the shorter diameter: more rarely, specimens show a longitudinal fracture. The abundance of specimens indicates that occasionally, after an implement had assumed nearly the desired shape, an unskilful stroke split it; and the pieces were allowed to fall with the



waste chips. Nos. 1–8 and 11 are such supposable instances. Both parts of No. 8 were picked up. Few entire or finished implements occur, as they would not be left in these places unless lost. Nos. 9 and 10 are complete; Nos. 12–14, roughly chipped and supposably unfinished.

Proximity to the supply of chert has doubtless determined this common occurrence of chippings in the sandy stretches near the lake. There is no evidence at hand of greater antiquity than the Indian.

W. A. PHILLIPS.

Evanston, Ill., Feb. 15.

Illusive memory.

For some time past, I have been investigating a curious psychical or psycho-pathological experience which is alluded to by many writers upon psychology, and is not infrequently met with in general literature. It is that vague sentiment of familiarity we sometimes have upon entering a new experience, best expressed in the words, 'I have seen or known all this before.' It has been explained by various writers, upon two widely different theories. The first is, that this 'double perception,' 'double thinking,' 'double presentation,' as it has been variously named, arises from the dual structure of the brain, resulting in cases of imperfectly correlated action in two images or impressions not absolutely simultaneous: the latter, therefore, is a repetition of the former, and gives rise to a sentiment that it has passed through the mind at some indefinite previous time. This theory, it will be observed, is a physiological one. The other theory is, that the phenomenon is a purely psychical one; that the false or illusory memory (Erinnerungstäuschung, Sander) has a real basis in some actual past presentation which is identical, or closely similar, with the present one; or in some past images of the waking imagination, or dream-life, that, although these cannot be recalled into consciousness, they are sufficient to give us the conviction that the present event is the repetition of a former one — why, or how, we do not know. There are several cases upon record, where this sentiment has assumed a pathological character, and become a continual delusion, attending every experience.

Two years ago, in the hope of obtaining more information, I distributed a question upon the subject among a large number of persons, principally college-students. It may now be given in somewhat amplified form, as follows: —

Have you come suddenly upon an entirely new scene, and, while certain of its novelty, felt inwardly that you had seen it before — with a conviction that you were revisiting a dimly familiar locality? Mention, if you can, an instance or two in which this has occurred. Has any satisfactory explanation of this experience ever suggested itself to you? How frequent is the experience in your case? Was it more frequent in childhood than at present? How soon do you usually become conscious of the deception? Does it occur more frequently in connection with some kinds of experience than with others?

A quantity of material upon this subject has already been collected in this and other ways, which I hope to publish in a review article in April. In the mean while, any information bearing upon this question will be of great assistance and value to me.

HENRY F. OSBORN.

Princeton, N.Y., Feb. 23.

Ripple-marks in limestone.

The alternating limestones, shales, and sandstones of the upper coal-measures of Kansas are well exposed along the ridges and water-courses near Eureka. Some of the limestone is thin-bedded, apparently due to interlaminated sheets of argillaceous material. The layers of limestone, however, seem to contain little foreign matter, certainly not more than the Trenton limestones (Buff) of Wisconsin and Minnesota. The organic remains consist largely of crinoid columns, shells of brachiopods and lamellibranchs, and a few gastropod shells and cup corals. Nearly every layer of limestone shows these remains in great abundance firmly bound together by the highly crystalline matrix.

I have been thus particular in describing the limestone, that the conditions which made the following feature possible may be understood. Some six or eight slabs of this limestone in one of our sidewalks are clearly and distinctly ripple-marked. This is the first instance of the kind that has fallen under my observation during ten years of state and private work in nearly as many states of the Union.

The occurrence of ripple-marks in calcareous mud containing the remains of deep-sea, clear-water animals, and interlaminated with argillaceous mud, is a combination not quite in accordance with the teachings of our text-books in geology.

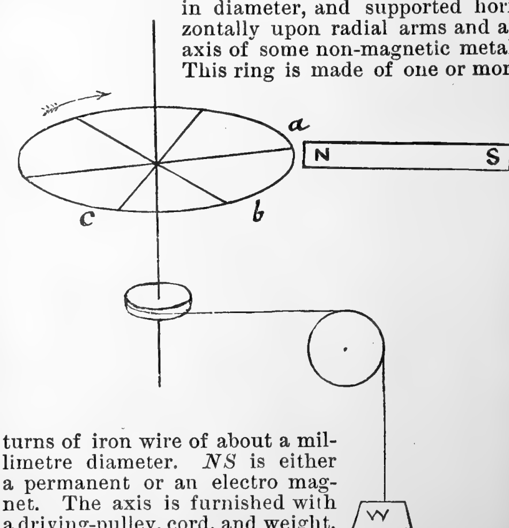
L. C. WOOSTER.

Eureka, Kan., Feb. 23.

A novel magnetic engine.

It is a well-known fact that iron, when heated to a red heat, ceases to be magnetic; so that an armature, after being heated to redness, may be removed from its magnet by the expenditure of only a small fraction of the energy which is developed by the attraction of the same armature when it has cooled.

Manifestly this fact might be employed in the construction of a motor, which, while of no practical value, is of theoretical interest, in which a permanent magnet should act as the direct motive force. This has been done in the following manner. In the figure, *a b c* represents a ring thirteen centimetres in diameter, and supported horizontally upon radial arms and an axis of some non-magnetic metal. This ring is made of one or more



turns of iron wire of about a millimetre diameter. *NS* is either a permanent or an electro magnet. The axis is furnished with a driving-pulley, cord, and weight, as shown in the figure.

That part of the ring which lies between *a* and *c* is heated to bright redness by means of two or three Bunsen burners. The magnet then exerts a preponderating attraction upon the farther or cool side of the ring, and the latter revolves as indicated by the

arrow. As fast as the ring enters the space $a\,b\,c$, it becomes red-hot and non-magnetic, and a lack of equilibrium is thus maintained which results in a continuous rotation.

The motion is necessarily quite slow on account of the considerable time required to heat the iron ring. In the actual experiment, moreover, considerable difficulty was experienced from the distortion which the ring underwent when softened by the heat, in consequence of which the speed of rotation became very irregular. With a permanent steel magnet, a speed of about one revolution in two minutes was obtained; and with a powerful electro-magnet, a weight of six grams was raised fifty centimetres in six minutes, and, in a second experiment (the ring having become quite distorted), ninety centimetres in thirty minutes.

Of course, the source of energy is the Bunsen burners; and the experiment leads at once to the fact, that the specific heat of magnetized iron is greater than that of unmagnetized. CHAS. K. MCGEE.

University of Michigan,
Ann Arbor, Feb. 19.

Congenital deafness in animals.

The communication of Professor Bell in No. 54 of *Science*, in reference to Mr. Lawson Tait's statement that no other animals than cats are affected with congenital deafness, calls to my mind the fact, that in my early boyhood I had a dog which was thus afflicted. I got him when a puppy; and, so far as we could determine, he was never able to distinguish any sounds. He was of the breed usually known as 'fist,' and, so far as my memory serves me, was of a yellow color: certainly he was not pure white. What renders this instance the more interesting, is the further fact, that a playmate of mine also had a deaf dog. I think he was of the same family, but not, I believe, of the same litter. That congenital deafness should be rare among wild animals, I can readily understand, since, in the struggle for existence, their defect would lead to an early extinction; but under domestication, where their conditions approach more nearly to those of man, I can see no reason why a defect of physical organization should not be transmitted by inheritance, as I believe it to have been in the cases above cited. It is a fact well known to aurists, that in some families there is a tendency to become hard of hearing, or even deaf, at about the same age; owing, doubtless, to certain evolutions which take place in their physical structure at that time. SWAN M. BURNETT, M.D.

Washington, Feb. 22.

A singular optical phenomenon.

The windows of our office are provided with fly-screens having the ordinary mesh of something less than an eighth of an inch. Thirty feet across the way is a building whose windows are protected by a coarse screen having a mesh a little less than half an inch in size. Standing about ten feet back from and looking through the fly-screen at the coarse screen, an inverted, magnified image of the latter is seen in mid-air, between the observer and the fly-screen; the inversion, of course, being only detected by the apparent movement made by the image on changing the position of the eyes. The explanation of the phenomenon is not difficult. The lines of the coarse screen throw nominally a single ray of light, which is inverted through the particular mesh of the fly-screen directly in line with it and the observer. Any other substance, such as a paper wad introduced in the coarse screen, will not appear in the image. It may not be uninteresting to mention in this connection the fact, that while a short-sighted person, to whom I endeavored to show the same phenomenon in my home, using as an object the slats of a blind in a house a hundred and fifty feet away, was unable to see the actual slats, owing to their remoteness, their image was distinctly visible to her. F. J. S.

Deflective effect of the earth's rotation.

In a letter of mine, published in *Science*, ii. No. 26, I suggested that the deflecting force produced by the rotation of the earth on bodies moving on its surface is not wholly represented by the rotation of a tangent plane, but depends, in part, on the centrifugal force resulting from the body's relative motion in longitude, and is therefore greatest when the motion is perpendicular to the meridian.

That my suggestion is *not* true, and that the force is the *same* for all directions of the motion, may be demonstrated very simply, as follows: —

From the proposition announced in section 25 of Peirce's 'Analytical mechanics,' it follows that any tangent plane whose latitude is λ rotates about an axis normal to that plane with an angular velocity equal to ω cosec. λ, ω denoting the angular velocity of the earth about its polar axis.

Therefore if P represent the point where the normal axis pierces the surface of the sphere, and if a body be caused to move in any direction over the point P with a velocity v, it will, by the rotation of the tangent plane, be constrained to describe in space the spiral of Archimedes, whose equation is $u = a\theta$; and when $\theta = 2\pi$, $u = v$ multiplied by the time of one rotation of the tangent plane. Hence, if one hour be the unit of time, $u = 24\,v$ cosec. λ; and $\frac{1}{2}a$, = the radius of curvature at the origin of the spiral, $= 6\,v \div \pi \sin\lambda$.

Now, the deflecting force at P is equal to the centrifugal force due the velocity v at the origin of the spiral, which is represented by $v^2 \div \frac{1}{2}a$:

$$\therefore f = \tfrac{1}{6}\,v\,\pi \sin\lambda.$$

But the centrifugal force, $V^2 \div R$, due the rotation of the earth at the equator, is known to be $\frac{1}{289}mg$; mg denoting the weight of the body, and $V = \frac{1}{12}\pi R$:

$$\therefore f : \tfrac{1}{289}\,mg :: \tfrac{1}{6}\,v\,\pi \sin\lambda : V^2 \div R;$$

whence, substituting for V^2, we get,

$$f = \frac{\frac{1}{289}\,mg\;24\,v \sin\lambda}{\pi R}.$$

The centrifugal force resulting from the body's relative motion in longitude affects only the origin of the spiral, and not at all its elements, and hence has no influence on the value of f: consequently f is the total deflecting force, and is independent of the direction of the motion. J. E. HENDRICKS.

Des Moines, Io., Feb. 14.

A carboniferous genus of sharks still living.

I observe that in a late number of *Science*, Mr. Garman describes a new genus of sharks from the Japanese seas, under the name of Chlamydoselachus. The figure of the teeth which he gives shows the animal characterized by Mr. Garman to be a species of the genus Didymodus (Cope, Proceedings Philadelphia Academy, 1883, p. 108, equal to Diplodus Agass. Poiss. fossiles, pre-occupied in recent fishes), which has hitherto been supposed to be confined to the carboniferous and Permian periods. The species possess two, three, or four denticles. Material in my possession enables me to fix the position of this genus, which I will endeavor to explain in the next (April) number of the *American naturalist*. Didymodus

becomes by this discovery the oldest living type of vertebrata. E. D. COPE.

Philadelphia, Feb. 28.

Artificial production of rain.

I give below an instance which came under my own observation, of the artificial production of rain, which may be interesting, read in connection with the article in *Science*, No. 55.

Many years ago, during my residence in Virginia, the whole of the eastern portion of that state had been suffering one summer from a long-continued drought. For several months not enough rain had fallen at any one time to moisten the ground to the depth of half an inch. The atmosphere was gray, and full of dust. The sun, even at noonday, was 'shorn of his beams,' and could be looked at directly without paining the eyes. The temperature was not unusually high; but the weather was very oppressive, being what is called in the country, 'muggy.' One of my neighbors had several months before cut down, and left lying where it fell, a young forest of scrub pines from a field of about forty acres in extent. These pines had, of course, become, during the long drought, completely dry. One August morning, the meteorological conditions remaining exactly as they had been for months before, my neighbor caused fire to be set to this clearing at several points on the circumference at the same time. The fire ran over the whole tract with wonderful rapidity. An immense column of inky smoke rose perpendicularly (there was no wind) to a great height. Upon reaching a stratum of air of its own density, the black column spread out horizontally into the form of a gigantic mushroom, rapidly changed color from jet black to gray, and soon thunder was heard in the top of the ascending and spreading column. The fuel was gradually consumed, and the smoke ceased; but the cloud continued to spread, and rain began to fall in a little more than an hour from the time the clearing was fired.

The thunder gradually ceased; but rain continued to fall until sunset, when the sky cleared. For the remainder of the season, showers and rain-storms occurred with ordinary frequency, as if the conditions favorable to the continuance of the drought had been permanently broken up. Observations of temperature, the dew-point, and of the barometer, would have been valuable; but I had unfortunately no instruments at hand for obtaining them.

While the artificial production of rain can have no economical importance, — depending, as it necessarily must, upon many meteorological conditions, which, to be effectual, must be synchronous, — yet an example of a rainfall of several hours' duration, which was undoubtedly produced by an ascending column of heated air artificially supplied, seems worthy of record. L.

Annual growth of the 'Tree of heaven.'

I have in the cabinet of Cumberland university two remarkable shoots of Ailanthus glandulosus, Desf., a description of which may be of interest to botanists. They grew in a lot near one of the university buildings during the summer of 1883. They sprang from small stumps, and are entirely the growth of one season. They give the following measurements:—

No. 1. — Length, 10 feet 6 inches; circumference at base, 5.1 inches; circumference at middle, 4.13 inches.

No. 2. — Length, 11 feet 1.5 inches; circumference at base, 4.1 inches; circumference at middle, 3 inches.

J. I. D. HINDS.

Lebanon, Tenn.

GOUVERNEUR KEMBLE WARREN.

IN the death of Gen. Gouverneur Kemble Warren of the Corps of engineers, U.S. Army, the country has lost not only one of the ablest military leaders developed by the civil war, but also a scientific man of high attainments, whose life was devoted to profound investigations connected with several of the most important works of internal improvement undertaken by the general government.

He was born on Jan. 8, 1830, at the little village of Cold Spring, upon the Hudson, where his surroundings were all calculated to excite a love for the military service in the mind of an active and intelligent boy. West Point lay in plain sight from his home. The old field-works of the revolution, grass grown and crumbling, were associated with his earliest recollections; and the charm thrown by Washington Irving over this classic ground of American history entered into and stimulated his youthful imagination to ideas above the prosaic monotony of every-day life in the nineteenth century. The Mexican war added fuel to the flame; and at the early age of sixteen he sought and obtained an appointment as cadet at the Military academy. He was graduated in 1850 with very high class rank, and was at once assigned to the corps of topographical engineers.

The great problem then beginning to attract attention was the Pacific railroad. The recent discovery of gold in California, and the consequent rush of immigration to the west, demanded increased facilities for transit across the continent; but a broad belt of wilderness, intersected by lofty ranges of mountains, and almost unknown, barred the way. It was in this field that the young officer did his first important scientific work.

Congress made large appropriations for exploring several routes between the Mississippi River and the Pacific Ocean; and the work, under the direction of Gen. (then Capt.) Humphreys, was performed by officers of U.S. engineers. As usual in such cases, the results were expected at once; and Lieut. Warren, who had already shown his ability on the surveys of the Mississippi delta, was detailed as principal assistant in the general office at Washington.

His duties were twofold. He assisted Capt. Humphreys, then laboring under great pressure, in digesting the preliminary reports, in investigating the various problems connected with railroad transportation, in making the comparative estimates of cost, and in preparing

the general report. His labors were so valuable in this connection that his chief placed their names jointly on the titlepage of what was a very able document. In addition to this work, Lieut. Warren was specially charged with compiling a general map of the entire region covered by the surveys. This labor demanded powers of analysis of a high order. It was needful to thoroughly study the work of all explorers to date, and, by assigning proper weight to each, to combine the material, often conflicting and discordant, into one consistent and harmonious whole. This task Warren accomplished with surprising success, as has been proved by accurate surveys subsequently extended over much of the ground. His memoir and map, which appeared in the eleventh volume of the final quarto edition of the Pacific railroad reports, will remain a standard authority to geographers studying the early history of exploration in that region.

As might naturally be supposed, an ambitious young officer would not be satisfied with office-work alone, when laurels were to be won in a field involving no little hardship and risk from the semi-hostile Indian tribes which then roamed unsubdued over the vast plains west of the Mississippi. He sought and obtained direction of three separate explorations in Dakota and Nebraska, in the years 1855, 1856, and 1857; and, while thus collecting much valuable information needful for opening the country to civilization, he gratified his own strong passion for geological research, and laid the foundation for subsequent generalizations which have attracted the attention of men eminent in that special branch.

Space forbids any notice of Gen. Warren's war record here. Suffice it to say, that, entering the volunteer service among the very first of the officers of the regular army (on May 14, 1861), in two years and three months he fought his way from the grade of lieutenant-colonel to that of major-general commanding an army corps. He was present at all the great battles of the army of the Potomac, and was justly regarded as one of the best generals and most gallant officers made known by the war. He was twice wounded in battle, and had several horses shot under him.

Immediately after the fighting ceased, he returned to duty as major in the Corps of engineers, and soon began to perform an amount of labor in the civil branches of his profession which would have broken down a man of less nervous energy. To simply enumerate the various works with which he was charged between the

end of the war and the date of his death on Aug. 8, 1882, would extend this notice beyond reasonable limits. They can only be classified and briefly explained.

As an expert in railroad-engineering, Gen. Warren served on three different commissions to inspect and report upon the construction of the Union Pacific and Central Pacific roads and their branches, and to indicate their proper point of junction.

His military experience caused him to be selected to make the detailed surveys of the battle-field of Gettysburg, and of the vicinity of Groveton, Va., in connection with the Fitz-John Porter investigation.

As an hydraulic engineer, his labors covered several of the most important works in the United States, and gave him great eminence. He was a member of the board to report upon the Fort St. Philip canal project, and was president of the commission of engineers appointed by special act of Congress to report upon the best method of protecting the alluvial region of the Mississippi against overflow. He conducted a very elaborate survey and investigation with a view to improve the navigation of the Fox and Wisconsin rivers; and his report, a model of excellence, has borne the test of practical trial subsequently applied. His surveys and reports upon the improvement of the upper Mississippi and of the Minnesota River are also of standard authority. His name is identified with the improvement of the Connecticut River, and with various harbor improvements upon the coast of Massachusetts, Rhode Island, and Connecticut; and his labors in hydraulic engineering at other special localities are too numerous to mention.

Gen. Warren also contributed much to the subject of bridge-construction. The Rock Island bridge was built essentially upon his plans and specifications; and his services upon boards ordered to report upon bridges projected or constructed at many important localities involved great labor and research. His reputation in this branch of engineering, however, will chiefly rest upon his monograph upon bridging the Mississippi River between St. Paul and St. Louis. This work was unique in character. The investigation was ordered by Congress to collect data for harmonizing the conflicting interests of navigation and of railroad transportation; and the subject was treated exhaustively, not only from an engineering, but also from a legal point of view. The investigations extended over a period of more than eleven years; and the report is a standard authority to be consulted in any future bridge-projects over navigable western waters.

Gen. Warren's natural fondness for geological research has already been mentioned. His extensive explorations in Dakota and Nebraska; his numerous surveys for determining the topographical features of the valleys of many rivers in Minnesota, Wisconsin, Iowa, and Illinois; his investigations in respect to foundations for bridges in this district; and his thorough familiarity with all the geological and topographical reports upon this vast region, and north of it in British America, — enabled him to frame an hypothesis as to geological changes that have occurred, and are now occurring there, which is both novel and brilliant. He first announced it in a paper read at the Chicago meeting of the American association for the advancement of science in 1868, and subsequently elaborated it in his report upon the Minnesota River and in that upon bridging the Mississippi.

Very briefly outlined, it is the following. Lake Winnipeg formerly covered much more space than at present, and extended southward to the head of the Minnesota valley, through which it drained, thus forming the source of the Mississippi. The present outlet to Hudson Bay (Nelson River) did not then exist. The change of drainage has been effected by an elevation of the southern, and a subsidence of the northern, portions of the continent, which have been in slow progress for a vast period of time. When this change began, it caused a decreasing river-slope in the northern portions, and a diminishing power to erode. The resistance due to the granite ledges extending over a hundred miles below Big Stone Lake, in the bed of the upper Minnesota, checked further erosion there, and formed a growing lake above it, which finally found a new outlet to Hudson Bay through the loose drift near Nelson River. This was rapidly eroded, thus reducing the old lake-surface to the present level of Lake Winnipeg, which is about three hundred and sixty feet below the present sources of Minnesota River. Like changes, due to the same cause, by which Lake Michigan has been cut off from the Illinois River, and Lake Winnebago from the Wisconsin River, may be traced.

Gen. Warren discussed this hypothesis in detail, and showed, by so many facts as almost to amount to a demonstration, that, since the glacial epoch, two secular oscillations of this character have occurred in this region. The reasoning is masterly, and illustrates both his breadth of conception, and his care to conclude no farther than the facts warrant.

Although modest and retiring to a fault, the

earnest scientific work which he had done and was doing was appreciated; and in 1876 he was elected a member of the National academy of sciences. He had long been a member of other learned societies, and was widely known and respected among scientific men.

In person, Gen. Warren was of medium height, and slightly built. His mind was intensely active. Nervous in temperament, and sometimes irritated at trifling annoyances, he became instantly cool and self-poised in times of real danger or difficulty. In close logical reasoning he had few superiors. His mental habits were those of an investigator, — never satisfied until he had studied the matter in hand in all its bearings; but in action he was impetuous, indomitable, and gallant in the extreme. His reading was extensive, both in science and literature, — due largely to his habit of seeking mental rest by working in a new direction. His sense of humor was keen, and his conversation was often brilliant as well as instructive. In disposition he was kindly and sympathetic, and he never failed to give others full credit for whatever good work they had done. He loved justice for its own sake; and the natural tendency of his mind was always to assist the weak, and to strive to redress wrongs wherever found. These traits of character endeared him to his friends; and his memory is cherished with mingled feelings of respect and regard, not easy to express.

HENRY L. ABBOT.

APPENDAGES OF THE TRILOBITE.

THROUGH the kindness of Mr. D. A. McCord, the owner of the trilobite described by Professor John Mickleborough (*Cinc. journ. nat. hist.*, vi. 200, 1883), I have had an opportunity to study the original specimen, and prepare a few notes upon it.

When received, the specimens — i.e., matrix and relief — were not free from the grease and dirt acquired in the process of taking casts and frequent handling. On giving them a thorough washing in a solution of potash, this was removed, and also a thin film of decomposed rock on the parts beneath the pygidium. Turning to the laboratory window, to have the sunlight strike across the specimens while still wet, much to my surprise, the appendages shown beneath the pygidium were seen to be of the same character as those beneath the thorax, a number showing in some instances two and three joints attached to the basal joint. On a more careful examination, numerous fine slender filaments were discovered, both beneath the thorax and pygidium, and also near the posterior end of the latter slender jointed appendages not half a millimetre in diameter. Having cut up over two thousand trilobites without discovering any 'branchigerous' appendages beneath the pygidium, other than the spiral and ribbon-like branchial filaments, — such as were attached to the basal joints of the thoracic legs, — naturalists can appreciate the feeling of satisfaction that the discovery of these jointed appendages, so much like those found in cutting sections of Ceraurus and Calymene, gave the writer.

The breaking-apart of the surfaces carrying the legs and their matrix left the legs beneath the thorax in relief; but beneath the pygidium the joints were broken longitudinally, and only a plain outline section is seen. It is probably owing to this that these were overlooked by Professor Mickleborough, and the space beneath the pygidium considered as showing leaf-like or foliaceous appendages. For the purpose of clearly indicating the actual relations of the portion of the Ohio trilobite showing the legs, to the entire dorsal shell of the same species, a figure of the under side of the shell was outlined; and then the Ohio specimen was carefully drawn as if resting in it, as shown in fig. 1. In the specimens, some of the appendages are shown more distinctly in the matrix, and others in the relief. In the drawing, the two are combined so as to give, without restoration, what is actually present in the specimens. Twenty-six pairs of appendages are clearly discernible. Of these, nine are situated beneath the thorax, one beneath the posterior margin of the head, and sixteen beneath the pygidium. From the character of the appendages beneath the thorax, none of them appear to have belonged to the manducatory apparatus; the ninth posterior pair having been crowded forward from beneath the pygidium. The anterior pair beneath the head is very imperfect; but sufficient remains to show that these appendages were intimately associated with the cavity of the head, which is now filled with calcite, and they probably represent a portion of the posterior pair of manducatory appendages. In Calymene senaria and Ceraurus pleurexanthemus, the posterior pair of manducatory appendages are always provided with a large basal joint, and undoubtedly the same was the case with other genera of trilobites. The appendages beneath the pygidium are, however, of the greatest interest. I have seen many trilobites, when cutting sections, that had the cephalic and thoracic legs clearly and distinctly defined; but, owing to the small size of the pygidium of Calymene

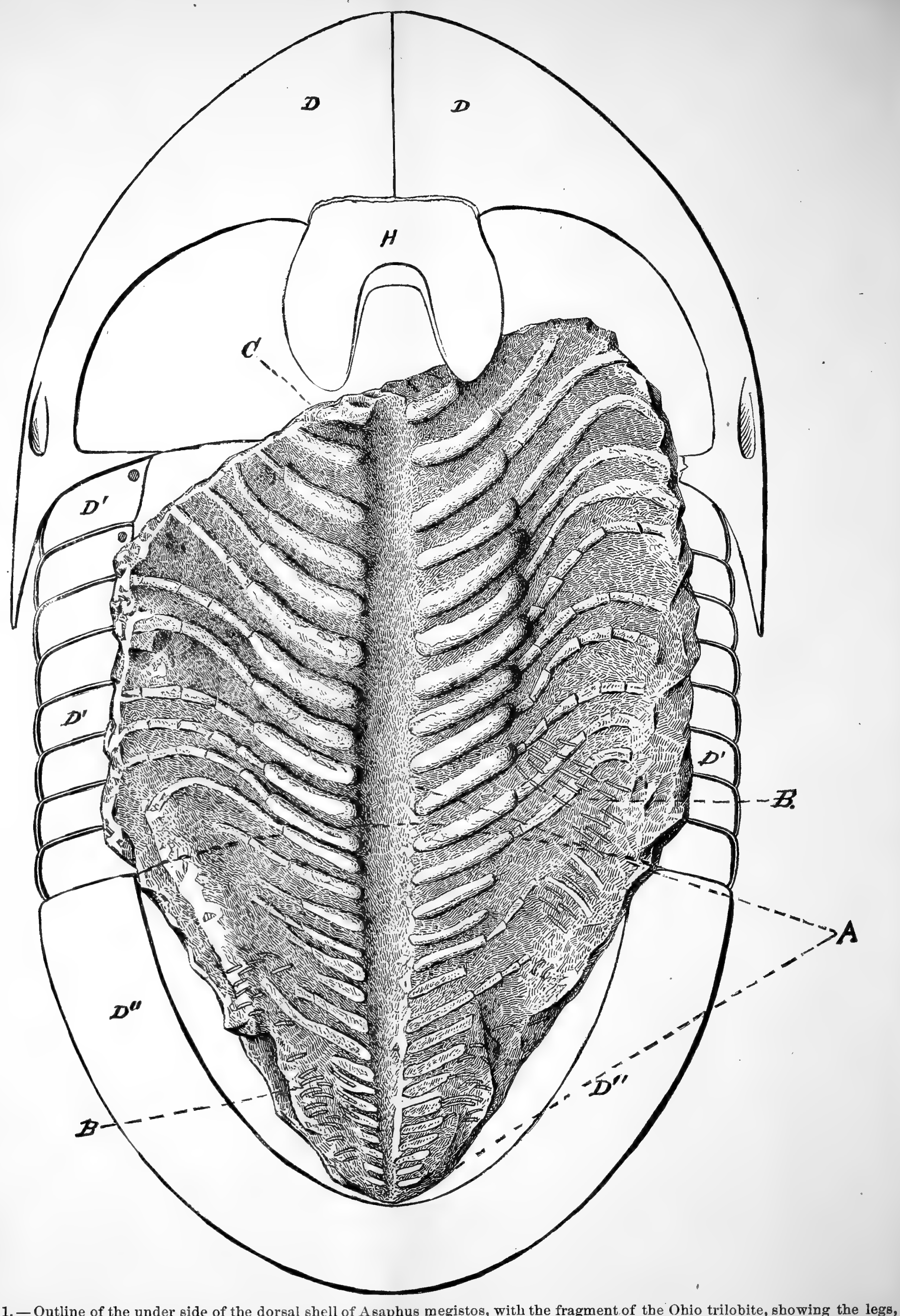


FIG. 1. — Outline of the under side of the dorsal shell of Asaphus megistos, with the fragment of the Ohio trilobite, showing the legs, resting in it. *H*, hypostoma; *D*, doublure or infolded margin of the dorsal shell; *D'*, same of the thoracic segments; *D''*, same of pygidium; *C*, portion of posterior pair of cephalic appendages; *A*, abdominal appendages; *B*, branchial filaments. The latter are enlarged to show their position.

and Ceraurus, there was always some doubt about the number of appendages that were to be assigned to the pygidium. That they were jointed and not foliaceous appendages, I had no doubt, and so stated it in the text,[1] and also in the restoration, of which fig. 2 is a copy.

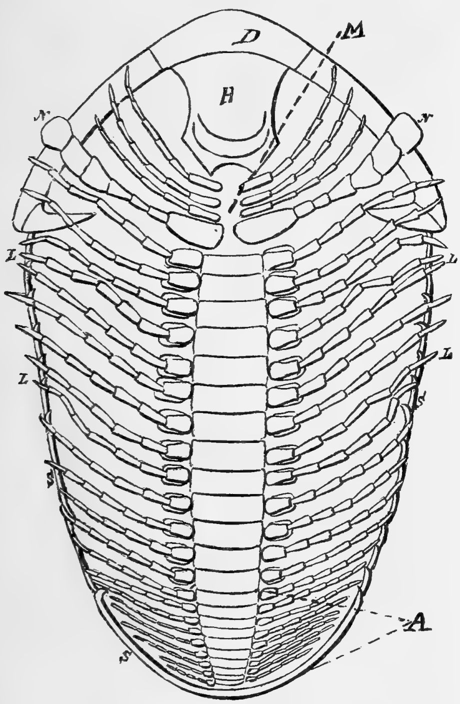


Fig. 2.—Under side of Calymene senaria as figured in *Bull. mus. comp. zoöl.*, vol. viii. pl. vi., 1881. *H*, hypostoma; *M*, mouth; *A*, abdominal appendages.

The leg beneath the thorax of the Ohio trilobite shows seven joints in two instances: the character of the terminal joint is unknown.

The discovery of this unique specimen fully establishes the correctness of the restoration made by the writer of the ambulatory appendages of Calymene, as shown in fig. 2. The few traces of the branchial filaments do not differ from those described as occurring in the genera Calymene, Ceraurus, and Acidaspis.

From the evidence given, there appears to be no necessity for a change in the classification of the trilobites given on pp. 209, 210 (*ibid.*): —

Class, Poecilopoda; sub-class, Palaeadae; order, Trilobita.

Trilobita: ex., Asaphus, Calymene, etc.

1. Eyes sessile, compound. 2. Ocelli unknown. 3. Cephalic limbs serving as mouth-organs. 4. Thoracic segments bearing jointed legs and attached branchiae. 5. All segments bearing appendages. 6. Thoracic segments unanchylosed. 7. Abdominal segments anchylosed, and bearing jointed appendages. 8. Hypostoma large (metastoma unknown). To section 7 we now add '(similar to those of the thorax).'

The attempt to locate the branchial apparatus of the trilobite beneath the pygidium is not surprising when a comparison with Limulus and Serolis is made with those trilobites having a large pygidium; but in such genera as Conocephalites, Arionellus, and others having a pygidium very small, as compared with the remaining parts of the animal, the necessity for a different branchial system is at once apparent.

The director of the Geological survey of Canada having given permission to have the original specimen of Asaphus platycephalus, described by Mr. Billings as showing ambulatory legs, sent to me, Prof. J. F. Whiteaves kindly forwarded it; and the specimen was placed by the side of the Ohio trilobite for comparison. A glance showed that Mr. Billings's interpretation was the correct one, and that, as far as the thoracic legs are considered, the Canadian trilobite has a pair for each segment. Of the abdominal legs nothing is seen. The only addition to our knowledge of the structure of the trilobite, furnished by the Ohio specimen, is the verification of the hypothesis that the legs were jointed beneath the pygidium, as shown in the sections of Ceraurus and Calymene, and expressed in fig. 2.

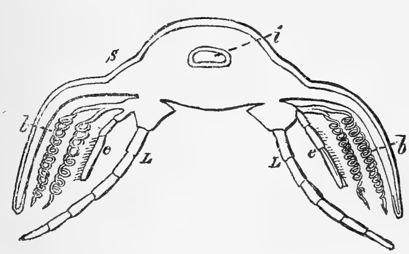


Fig. 3.—Cross-section of fig. 2. *s*, dorsal shell; *i*, alimentary canal; *B*, spiral branchiae; *e*, epipodite; *L*, leg. Taken from same plate as fig. 2. In some instances the branchial filaments or ribbons are straight and not spirally coiled.

That the trilobites and crustaceans were differentiated before the existence of the oldest Cambrian fauna we now know, is my present belief, the two classes coming down on two distinct lines of descent. In a paper now in the course of preparation, the entire subject will be reviewed, and illustrations given of the different orders of the class Poecilopoda.

Charles D. Walcott.

[1] *Bull. mus. comp. zoöl.*, vol. viii. p. 204, 1861.

THE NEW BOGOSLOFF VOLCANO IN BERING SEA.[1]

On Tebenkoff's chart of Unalashka Island, and the adjacent passes from Unimak to Umnak Islands, there is placed in latitude 53° 51′ north, and longitude 167° 40′ west, an islet about half a mile in extent, with rocky, bold shores, and somewhat flattened top. It has deep water close around it, and no outlying dangers except to the north-north-west, where a small 'pinnacle rock,' or 'sail rock,' lies a few hundred yards distant.

The rocky islet is known as 'Bogosloff.' In his account of his voyages,[2] Cook says, that on the 29th of October, 1778, he discovered 'an elevated rock which appeared like a tower;' and he judged of its steepness below the surface of the sea by the circumstance that the sea (which was running very high) broke nowhere but against its sides.

I have plotted Cook's position with regard to this discovery, made when he was only four leagues to the south-westward of the islet, and was steering a north-easterly course. From his language, I cannot decide whether he passed on its northern or southern side.

His footnote says, that, though this mass had no place on the Russian map produced by Ismyloff,[3] it was indicated on the chart of Krenitzen and Levasheff. Cook placed it about seventeen miles north of the northern shore of the island of Umnak. His longitudes are all too great by more than a degree, but the relation of the islet to the adjacent islands fixes its position.

This reference to Cook's position is somewhat important; because, on an admiralty chart of Bering Sea and the Arctic Ocean (1859), and on a U. S. chart corrected to 1868 (Exploring expedition under Commander John Rodgers, U.S.N.), this islet is called the 'Bogosloff volcano;' and the statement is made that it rose in 1796, — eighteen years after Cook had described it.

Tebenkoff, in 1848 (perhaps following Saricheff in 1829), calls it 'St. John the theologian Island,' or, rather, 'rock,' and gives it a circumference of two miles. According to Saricheff, its height is about four hundred feet; but the navigators of the Russian-American company made it six hundred and twenty feet. Tebenkoff says Pillar Rock lies four hundred yards north-north-west of Bogosloff Island.

[1] Communicated by Prof. J. E. Hilgard, superintendent U.S. coast and geodetic survey. See also *Science*, No. 51.
[2] Vol. ii. p. 526. Third admiralty edition.
[3] Ismyloff was the principal trader at Unalashka, and had produced charts of several of the islands, etc., with which he was personally familiar, and showed them to Cook.

On the admiralty chart and on some of the Russian charts (including those of Saricheff), and even on the chart published by the U. S. hydrographic office in 1855, a dangerous reef is laid down between Bogosloff and the northern end of Umnak. The U. S. chart, corrected to 1868, repeats this danger; and it is even laid down on the U. S. circumpolar chart of 1882. Tebenkoff says this 'dangerous reef' does not exist: Veniaminoff says the natives deny the existence of the reef, but report great current or tide rips, which are dangerous to their bidarkas. In 1867 I had the same information from the Russian priest, Shayesnikeff, — a man of more than ordinary knowledge and capacity, and well acquainted with the islands, which he visited regularly in the course of his ministrations: also the Alaska commercial company's navigators have passed between Umnak and Bogosloff islands. Neither the Bogosloff, the reef, nor the northern part of Umnak, is on Kotzebue's chart of 1817.

The height of this volcanic island varies according to the authority from which the estimate has been obtained, as already indicated. Tebenkoff gives estimates, from two authorities, of four hundred and six hundred feet. On my chart I have a note stating the height to be eight hundred and forty-four feet, but I had forgotten to state the authority for that estimate. I suppose that I obtained it from one of the Russian navigators, in 1867. The captains employed by the Alaska commercial company, however, estimate the height at from two hundred and fifty to three hundred and fifty feet.

Of this islet I collate the following facts, without examining many authorities: —

1778. — Cook saw it, Oct. 29, in clear weather. He says it is on the charts of Krenitzen and Levasheff.

1796. — Veniaminoff, calling it 'St. John the theologian,' states that it arose out of the sea on May 7 of this year; and that, at the time, there were, according to Krusenstern and Langsdorff, earthquakes and eruptions.

1800. — It was smoking (Kotzebue).

1802. — It was smoking (Langsdorff). (At that time the volcano Makushin was throwing out volumes of smoke and fire.)

1804. — It was smoking from one crater (Kotzebue).

1806. — The burning lava was flowing down the north side (Langsdorff).

1814. — The crater threw out stones (Baranoff).

1815. — It was diminishing in height (Baranoff).

1816–17.—It had no activity (Eschscholtz).
1820.—It was smoking (Dr. Stein).
1823.—It was not smoking (Veniaminoff).
1832.—There was no smoke (Tebenkoff, Lütke).

Although frequently seen in later years by the navigators of the Russian-American and Alaska commercial companies, and by the whalers, no one has noticed it as exhibiting any signs of activity.

In an other part of Veniaminoff's work, in giving more particulars of earthquakes and volcanoes, he writes,—

"The new island, Bogosloff, in latitude 53° 58′ north,[1] and longitude 168° 5′ west, rose from the sea in the early part of May, 1796. Before the island appeared above the sea, there had been witnessed, for a long time in that spot, a column of smoke. On the 8th of May, after a strong subterranean noise, with the wind fresh from the north-west, the new small, black islet became visible through the fog; and from the summit great flames shot forth. At the same time there was a great earthquake in the mountains on the north-west part of Umnak Island, accompanied by a great noise like the cannonading of heavy guns; and the next day the flames and the earthquake continued. The flames and smoke were seen for a long time. Many masses of pumice-stone were ejected on the first appearance of the island."

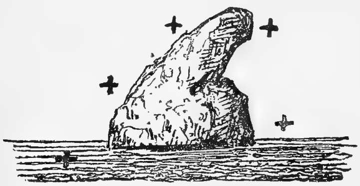
At that time it was, perhaps, only one-quarter the size of its present dimensions; and it increased in size, growing higher, and breaking down at the same time on all sides. Finally, about 1823, it seemed to become unchangeable. Until it ceased to increase in size, it was hot, as well as the sea-water around it; while smoke and steam arose from it continuously.

It is noticeable, also, in this connection, that Krenitzen and Levasheff, who made the voyage of discovery in 1768 and 1769 to endeavor to discover the track of Bering's voyage, have marked Bogosloff on their chart as situated forty miles west by south of Makushin volcano, and surrounded by sunken rocks. Their mark is a view (see sketch), and clearly indicates the peculiar shape of the islet at that time. Their course led them ten miles to the northward of it. So much for the older authorities.

Along the whole chain of the Aleutian Islands, from abreast of the Kamtchatka peninsula to the head of the peninsula of Alaska, there is a line of the greatest volcanic activity exhibited by about fifty volcanoes, of which many are living, and of which some are at times in a state of violent eruption. Some of them have an extreme elevation of about twelve thousand feet on the Alaska peninsula; while the Aleutian volcanoes range from three thousand to nine thousand feet.

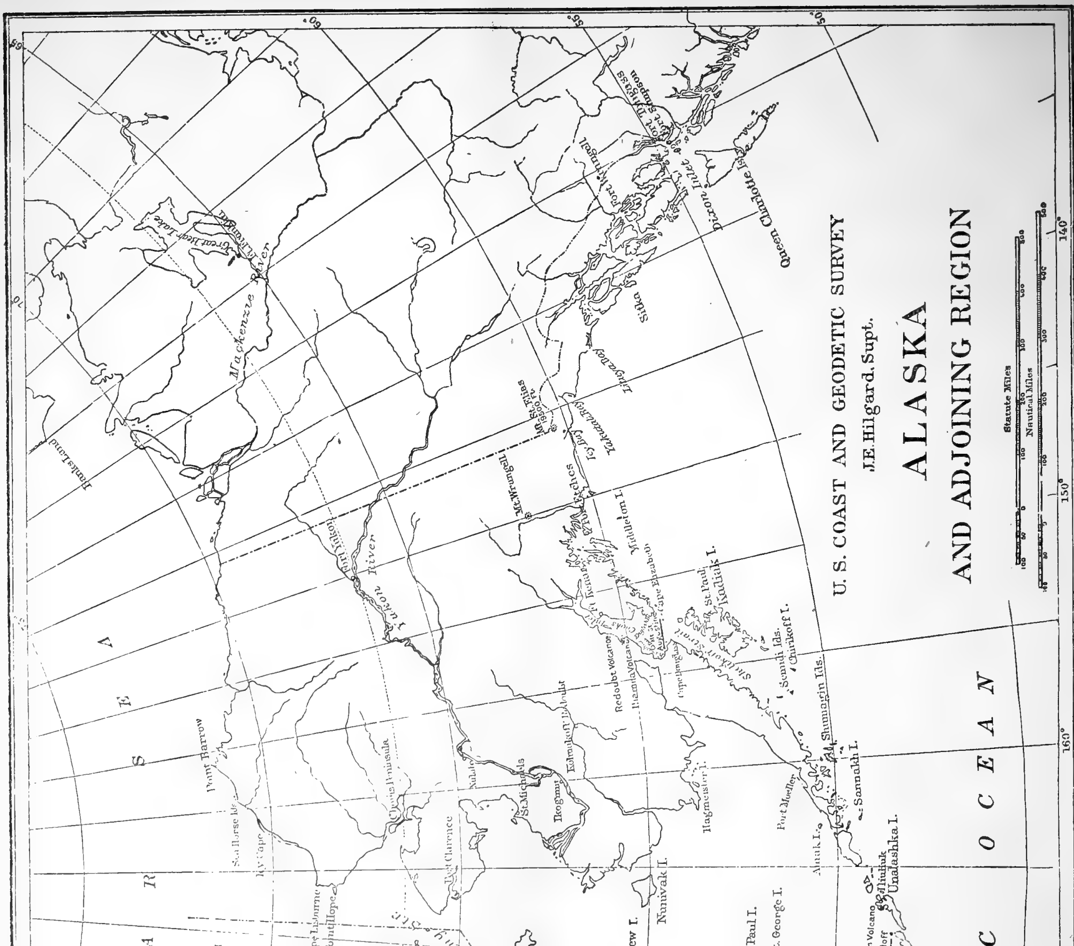
[1] This latitude agrees with Cook's.

Of these living volcanoes, one is that of Makushin, on the north-western part of the large island of Unalashka, and directly overlooking Captain's Harbor, on the north side of that island; and another is the islet of Bogosloff, now under discussion, situated twenty-five miles to the westward of the north-western point of Unalashka. This islet has acquired unusual importance, because there has arisen alongside of it, from the depths of the ocean, a volcanic island over one thousand feet high. This fact also suggests inquiries into the condition of the island seen by Cook as 'an elevated rock which appeared like a tower,' and its condition in May, 1796, when it seems to have exhibited unusual signs of activity. Also it appeared, as before mentioned, to have increased in size, and continued so to do as late as 1823. It is possible that Cook saw the rock when in a state of inaction, as he made it out at a distance of four leagues, when working to the eastward under the northern shore of Unalashka; and the weather must have been clear. I conjecture that he sailed between it and Unalashka to save getting too far to leeward; and he must have had it in sight for several hours.



BOGOSLOFF ISLAND, DISTANT TEN MILES, AS SEEN BY KRENITZEN AND LEVASHEFF, 1768–69.

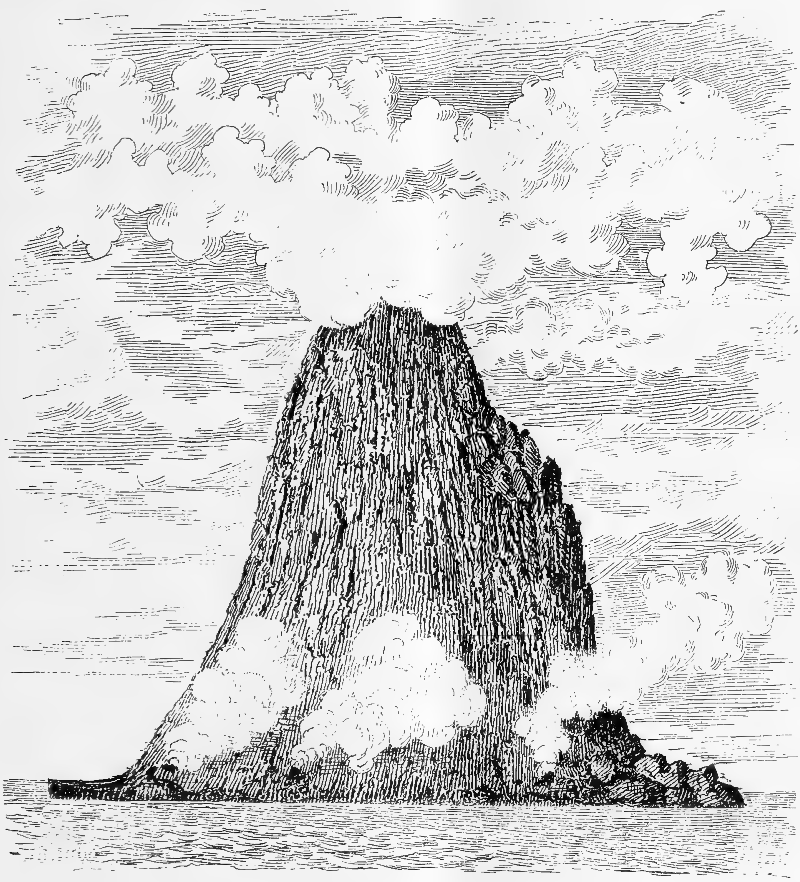
As late as September and October, 1883 (to come down to our own times), the island was seen by two captains in the service of the Alaska commercial company,—Hague and Anderson,—both of whom called upon me, described the character of this new formation, and enabled me to make a rough sketch of the islet as it appeared to them (see view). They both passed close to it, approaching from opposite sides, and thus were enabled to judge of its size, height, and general appearance. Capt. Anderson, in the schooner Matthew Turner, saw the island at daybreak (five A.M.) on the 27th of September, 1883, and passed it at half-past eight A.M. within three cables' lengths; heaving the lead as fast as practicable, with twenty fathoms of line, and finding no bottom, although the water was discolored and of a red color. The vessel first approached it on the eastern side, stood up to the north-westward, tacked ship, and passed to the west-


U. S. COAST AND GEODETIC SURVEY
J.E. Hilgard, Supt.
ALASKA
AND ADJOINING REGION
Statute Miles
Nautical Miles
POLAR SEA
BERING SEA
NORTH PACIFIC OCEAN
Mackenzie River
Great Bear Lake
Yukon River
Fort Yukon
Mt. St. Elias
Mt. Wrangell
Sitka
Dixon Inlet
Queen Charlotte Is.
Middleton I.
Kadiak I.
Chirikoff I.
Semidi Ids.
Shumagin Ids.
Sannakh I.
Unalashka I.
Unimak I.
Bogosloff
Makushin Volcano
St. Paul I.
St. George I.
St. Mathew I.
Nunivak I.
St. Lawrence I.
St. Michaels
Point Barrow
Icy Cape
Cape Lisburne
Point Hope
East Cape
Port Clarence
Wrangell Land
Herald I.
Atka I.
Adakh I.
Kyska I.
Amchitka
Attu I.
Commander Ids.
Kolyma R.
Indigirka R.
Penjina Gulf
Hagmeister I.
Port Moeller
Redoubt Volcano
Iliamna Volcano
Yakutat Bay
Port Simpson
Portland Inlet
Cape Elizabeth
Kotzebue Sound
Banks Land
60°
55°
50°
65°
70°
140°
150°
160°
170°
180°
190°

ward. The islet was surrounded by white smoke, like steam. The same evening, after nightfall, being then about twenty-five miles to windward of it, they saw the fire on the island.

On the 27th of October, 1883, just one month after Anderson's visit, Capt. Hague, of the Dora, saw the island at seven A.M., approaching it from the south-westward (just as Cook had done one hundred and five years before). He first passed through a streak of red water into a green streak beyond it (the water under both conditions having the appearance of being very deep), but, fearing shoals, tacked ship to avoid a nearer approach. He came no nearer than about one mile, and had the island in sight about three hours. At that time there was black smoke issuing from it, as if tar were burning. The weather was cloudy, and no observations could be had for position; but its proximity to the old Bogosloff fixes it with equal precision.

Both captains agree in saying that the island is larger than the old one, and is about half a mile north-north-west of it; that it rises very steeply, with a rough, ogee curve; and that the outline on the eastern side is broken on the shoulder and at the base by masses of rocks (see view, below). On the western side there is a level space just above water, and thirty or forty feet in extent, where a landing could be effected. The top was hidden by clouds; but white smoke or steam could be seen issuing from near the cloud-line, which was estimated to be from eight hundred to twelve hundred feet above the sea. The sides are very steep; and, apparently, it has arisen from the depths without developing outlying dangers, because, with a heavy swell running, no breakers were seen. Around the base are great steam-jets, somewhat like those near the summit. At night it looks as if the whole islet were in active eruption, and covered with fire (this



THE NEW VOLCANIC ISLAND OF BOGOSLOFF AS SEEN SEPTEMBER–OCTOBER, 1883.

may arise from the ignition of gases escaping from innumerable apertures in the flanks of the islet).

Tebenkoff, in his description, tabulates this islet as in latitude 53° 52′ north, and longitude 167° 39′ west.

I have no doubt that during the present year (1884) we shall obtain its exact geographical position, its physical conditions, and reliable measures of its size and height.

On the 20th of October, 1883, — seven days before Hague saw the island, — a shower of ashes took place, small quantities of which were collected at Iliuliuk, and a portion presented to the California academy of sciences. There seems some doubt, however, as to the point whence the ashes came; as the account from Iliuliuk places the date of their fall at Oct. 16, *wind being fresh from west-south-west*, with rain and sleet. It may be that this pumice-dust came from the eruption of Mount St. Augustin (see map of Alaska) on Oct. 6, under the influence of an upper current of air from the north-eastward; that mountain lying over seven hundred miles distant in that direction from Unalashka.

It is noticeable, that during the eruption from Bogosloff, or at least about that time, the two volcanoes on Akontan Island (about as far to the east-north-east of Makushin volcano as Bogosloff is to the west by north) ceased to smoke, and showed no signs of activity. These two volcanoes, only three miles apart, are 3,332 and 3,888 feet high respectively. Nothing was heard from Makushin: probably its summit was in the clouds, and might have been active.

As regards the distance to which the ashes from such eruptions are sometimes carried, it may be mentioned, that at the time of the eruption of volcano Iliamna, in March, 1867, the pumice-ashes fell on St. Paul, Kadiak Island, one hundred and sixty-five miles distant.

From the natives of Iliuliuk it was quite recently learned that they had seen smoke issuing from the new Bogosloff — or, rather, from the position of the Bogosloff — some time in 1882: the exact date could not be obtained.

GEORGE DAVIDSON,
Assistant U.S. coast and geodetic survey.

THE DANISH EXPEDITION TO EAST GREENLAND.

THE report of Lieut. Holm has appeared in the *Dagblad* of Copenhagen. He left Nanortalik on the 23d of July last, with a party of thirty-nine people, nine kayaks, and four umiaks, and reached Fredericksthal, the last European station, the same evening. Here they were assisted and entertained by missionary Broadbeck until the end of July, while the party was detained by the presence of floe-ice in the vicinity of Cape Farewell. From the 31st of July until Sept. 11 the party was not much incommoded by ice, only losing three days while detained in Lindenow Fiord.

The charts of East Greenland as far as latitude 61°, where the work terminated, will be notably changed, especially by the discovery of extensive fiords, until now unknown. Their shores are generally bare and vertical, or nearly so. In many places snow lies all summer. The sea-ice reaches to the bases of the cliffs, or even several miles into the fiords. Except at the extreme south, vegetation is even less abundant than in West Greenland, and is sometimes wholly absent. The southernmost of these fiords, some thirty-eight miles long, reaches within ten miles of the head of the Tasermint Fiord, which opens on the western coast. Both are full of ice. South of the sixty-first degree of latitude, and even a few miles northward from it, nothing could be seen of the inland ice characteristic of West Greenland. In that vicinity, from a mountain peak three thousand feet in height on Iluilek Island, they were able to see that the interior of the country for a great distance was composed of grand mountains, often rising over seven thousand feet above the sea.

In the fiords explored in 1883, there were found no remains of buildings erected by the Northmen, except those in Lindenow Fiord, the most southern of all, already described by Broadbeck. A great number of Eskimo ruins were noted in the different fiords. Sixty of these uncivilized natives were met going to trade with the people of West Greenland. They were much less like the typical Eskimo than those of the western coast. The men are almost always tall and slender, with long beards, and at a distance resemble Europeans. Some of them were even handsome, and the women were much prettier than those of West Greenland. In summer they lead a nomadic life, going from one fishing or hunting place to another. In winter several families unite to build huts covered with turf and stones, like those of West Greenland. They spend this season hunting seal and bears.

When the natives of Holm's party arrived at about latitude 61°, they refused to continue farther, fearing that the umiaks might be frozen in, as the ice began to knit together every night. On the most northern point attained, a hut was erected, and a depot made for the use of the expedition during the coming summer. Provisions and several boats were left here, and Holm returned with his party to Nanortalik. Here winter quarters were prepared, and a magnetic and meteorological observatory established. Magnetic observations are to be taken hourly from eight A.M. to midnight; on term days, every five minutes; and from four A.M. to four P.M., every minute. Arrangements have been made for simultaneous observations at the commercial stations of Denmark, in West Greenland.

After the winter quarters had been prepared, it was the intention of Holm to examine the fiord of Fredericksthal, and the region between it and Tasermint, which has not yet been explored with care.

It was his intention to start for the eastern coast about the end of April, or early in May, 1884; and during the winter of 1884–85 some members of the party were to remain there.

HUMIDITY AND CHRONOMETER RATES.

MAJOR-GEN. J. F. TENNANT, of her Majesty's mint, Calcutta, communicated to the Royal astronomical society in November last a paper on humidity as a cause of variation in the rate of chronometers. He had borrowed from the government-stores about the end of March, 1882, a chronometer, by Fletcher of London, which had been some time in India, but had not been cleaned since its arrival, and was said to have a good rate. From a gaining-rate of 6s.5, which it preserved fairly well for about two months, it suddenly fell to a gaining-rate of 2s.0; this being the commencement of a succession of rather abnormal fluctuations of rate which Major Tennant carefully observed and recorded for about eighteen months. These rates were first compared with a plot of the published daily mean temperatures of the meteorological observatory, with results not quite satisfactory; for, though it would seem at first sight that the rate depends on temperature, further examination showed that it can do so to a moderate extent only, and confirmed the belief, which Major Tennant had from general impressions, that rate does not depend on temperature. The extraordinary differences of rate at times of nearly equal temperature leave no doubt that there is a periodic change of rate; and the cause of this, Major Tennant believes to be humidity. His first suspicion of this was raised by the sudden fall in rate of this chronometer, in 1883, being coincident with the first heavy rains producing great damp; and by the fact, also, that the same thing occurred the year previous, and that the whole period of low gaining-rate was that of the rains, while the lowest was the warm time at the end of the rains, when the soil is generally loaded with moisture. The same phenomenon recurred. It is, however, much more difficult to compare the supposed cause and effect without special arrangements; and, in any case, it is doubtful whether air-humidity could be more than a rough guide.

If the oil in the arbors of the balance be hygroscopic, it is easy to see that it may become more fluid in damp weather, the arc of oscillation will increase, the balance-vibration take longer, and the chronometer lose; but the momentary humidity of the air will not correspond to the rate, as the temperature does more or less. Major Tennant, remarking the undoubted connection in this particular case, suggests special experimenting in the following directions: —

1°. Are chronometer-oils, or any of them, hygroscopic?

2°. Can they become so by exposure to a tropical climate?

In this latter case he conceives that the climatic influence cannot be imitated in Europe. The effect of the heat, and probably the light, are very destructive of some materials. Vulcanized india-rubber, for example, does not bear exposure in India, though it seems to answer in Europe, even in heat and damp.

Lastly, in estimating the effect of humidity on a given chronometer, it will probably be best to use one of the old hair or grass hygroscopes for the humidity, placing it in the case, enclosed with the chronometer. DAVID P. TODD.

THE GREAT COMET OF 1882.

THIS comet is one of the most interesting that has appeared for a number of years, owing to its very near approach to the sun-surface, and the resemblance of its orbit to the two great comets of 1843 and 1880. It was a brilliant object in the morning sky in September, 1882. Calculations of the orbit have been made recently by Dr. Morrison, Professor Frisby, and Dr. Kreutz. The periods obtained are as follows: Dr. Morrison, 712.1 years; Professor Frisby, 793.9; Dr. Kreutz, 843.1. These periods are, however, somewhat uncertain, owing to the peculiar nature of the nucleus of this comet. Instead of being a single bright body, there appeared to be a row of small nuclei, so that it was a mere matter of judgment with the observer what part of the comet he should observe. The observations were naturally made upon the middle of the row of points, and it is not possible to say with certainty that this corresponded to the centre of gravity of the comet. It is worthy of note, that bright comets are recorded in the year 370 B. C. and in A.D. 1132, both of which could be reconciled with the great comet of 1882 by supposing the period of 751 years.

THE WORK OF THE CAMBRIDGE ARCHAEOLOGICAL MUSEUM.

THE trustees of the museum of American archaeology and ethnology, founded by George Peabody, held their annual meeting on the 18th of February, the anniversary of the birth of the founder. The Hon. Robert C. Winthrop, president of the board, presided; and Professor Asa Gray, Dr. Henry Wheatland, Mr. John C. Phillips, Mr. Samuel H. Scudder, and Mr. F. W. Putnam (the curator of the museum) were present. The Hon. Stephen Salisbury of Worcester was prevented by temporary illness from attending, and the Hon. Theodore Lyman was unable to leave his duties in Congress.

The report of the treasurer, Mr. Phillips, showed that the $150,000 given by Mr. Peabody is well invested. Of the income of $8,334, only $5,186.50 was expended on account of the museum: $3,110 belonged to the building-fund, and the remaining $37.50 was expended on insurance. Mr. Winthrop

called attention to the wide-spread operations of the museum, which had so far exceeded the early expectations of the trustees as to have entirely outgrown its foundation. The original fund, although a munificent gift at the time, is now inadequate, owing to the unforeseen growth of the science. He hoped that in any account which might be given of this meeting, it would be clearly stated that this trust is in no way connected with the Archaeological institute of America, with which it has, no doubt, been confounded in some minds.

Mr. Putnam, the curator, presented his report of the operations of the year, in which he dwelt at length on the explorations which had been carried on by means of the subscriptions of several patrons of science. With about $1,600, the balance of the special subscription-fund of 1882–83, and less than $1,000 spared from the income, work has been continued in Nicaragua and Ohio, and, in a very limited manner, in Tennessee and North Carolina.

The work in Nicaragua has been conducted for the past five years by Dr. Flint, who has made very important collections from the ancient shell-heaps and burial-places. During the past year, on Deadman's Island, in a trench lined with stones, he found a burial-jar containing decayed human bones, with old Venetian beads, and two gold ornaments like those found in the graves at Chiriqui. This shows that gold ornaments of this type were used by the natives of Nicaragua after the Spanish conquest had furnished them with glass beads. As they are exceptional among Nicaraguan antiquities, and are identical with those from farther south, it is probable that their original source is Chiriqui. Dr. Flint has copied successfully many pictographs and cave-inscriptions, some of which are of great antiquity. But the most interesting discovery is what Dr. Flint believes to be human footprints in clay under several layers of lava-rock, on the borders of Lake Managua. Under date of Dec. 24, 1883, Dr. Flint writes that he has cut out several of these footprints, which, with fossil leaves from the same stratum, are now on their way to the museum.

The work in the Little Miami valley has been continued with remarkable success, and has resulted in discoveries of far greater importance than could have been anticipated from previous exploration of the mounds. A year ago attention was called to some early results of this exploration; but now, just as the means for continuing explorations are wanting, the discovery has been made, that, important as these mounds have proved to be, as much of interest is to be found beneath them. At the bottom of the largest mound, under a layer of burnt clay enclosed by a stone wall, trenching has brought to light a series of pits six to seven feet deep. These pits are connected with tunnels of clay a foot in diameter and seven to eight feet long, ending in upright tubes five inches in diameter and two feet long. Fine ashes were found on the bottom of the tunnels or flues, and on the sides a glossy substance, as if the product of condensation and crystallization of vapors. The pits were partly filled with ashes containing minute pieces of burnt bone, and the sides and bottom bore marks of fire. Two pits had dome-like covers of clay, in one of which were two small holes. A tube of clay opened into one pit opposite the flue. Although these facts seem to point out the manner of burning the dead in use among the people who built this group of tumuli, it would be premature to make such an assertion. This work has been under the direct supervision of the curator and Dr. Metz. It is unquestionably the most thorough and important exploration of a particular group of earth-works yet made in Ohio. Many mounds varying in structure, and evidently made at widely different times, have also been carefully opened; and several Indian burial-places and village sites have been examined. When this work in the Little Miami valley is completed, it will bring us nearer the solution of the problem, who built the mounds? Guessing will still go on, but thorough exploration by careful hands alone can give to science the answer it demands. The work is far more extensive than most persons imagine. The land has been hired by the museum, with exclusive right of excavation. It will be necessary to dig over a large area, including the whole altar-group, to trace in a systematic manner the underground works. A number of laborers will be required for months to come. Funds are therefore needed at once, that the work may be continued without interruption.

In closing his report, the curator urged the necessity of some immediate action for the preservation of the interesting monuments of aboriginal art, scattered over our western states. Probably nearly all which are in such condition as to be worth saving could be purchased at fair prices. Their owners, as a rule, would be glad to see the ancient works preserved, but do not feel able individually to sacrifice so large an amount of farming-land for the purpose. Special mention was made of the Hopeton works, with its twelve-feet embankments and large square and circle; the Cedar-Bank works, which are still well preserved, in the Scioto valley; the Great Serpent, 1,415 feet long, the only work of the kind in the country; the Stone Fort, enclosing fifty acres, known as Fort Hill, in the Brush-creek valley; Fort Ancient, with its four miles of wall, the largest of the many ancient fortifications in the United States, on the Little Miami River; Cahokia Mound in Illinois, the great pyramid of the Mississippi valley, and the largest tumulus in the country, nearly one hundred feet high, and covering an area of over eleven acres; and the singular group of low effigy-mounds in Wisconsin. Some of these mounds are more than a thousand feet long. Many other ancient works are equally worthy of preservation; but those mentioned had been recently inspected by the curator. With every year that passes, some mound or great embankment is levelled for economic purposes, or for the easier cultivation of the land; or the old walls of the hill-forts, which have stood for untold centuries, are thrown down. Forty years ago many of the works were perfect which are now nearly obliterated. Our children will not be able to trace their sites, unless destruction is immediately checked.

VORTEX RINGS.

A treatise on the motion of vortex rings. An essay to which the Adams prize was adjudged in 1882, in the University of Cambridge. By J. J. Thomson, Trinity college, Cambridge. London, 1883. 19 + 124 p. 8°.

Those cases of fluid motion in which no rotational motion is present, are, as is well known, readily amenable to analysis. Helmholtz [1] first called attention to the nature of the analysis by which rotational motion must be treated. This memoir was followed by Sir William Thomson's suggestive paper on vortex atoms,[2] and finally by his important mathematical memoir on vortex motion.[3] The very great mathematical difficulties of the theory have operated to prevent almost entirely farther progress in the investigation of this otherwise alluring subject. To the best of our remembrance this essay is the first systematic attempt, since 1869, to enlarge our knowledge of the theory of vortex rings. How great the difficulties to be vanquished are, may be imagined from the appearance of the pages of the essay before us, which bristle with periodic series and complicated expansions.

The scope of the essay may perhaps be best apprehended from its opening paragraphs, which we quote: —

"The theory that the properties of matter may be explained by supposing matter to be collections of vortex lines in a perfect fluid filling the universe has made the subject of vortex motion at present the most interesting and important branch of hydrodynamics. This theory, which was first started by Sir William Thomson as a consequence of the results obtained by Helmholtz in his epoch-making paper, *Ueber integrale der hydrodynamischen gleichnungen welche den wirbelbewegungen entsprechen*, has *à priori* very strong recommendations in its favor; for the vortex ring obviously possesses many of the qualities essential to a molecule that has to be the basis of a dynamical theory of gases. It is indestructible and indivisible; the strength of the vortex ring, and the volume of liquid composing it, remain forever unaltered; and if any vortex ring be knotted, or if two vortex rings be linked together in any way, they will retain forever the same kind of be-knottedness or linking. These properties seem to furnish us with good materials for explaining the permanent properties of the molecule. Again: the vortex ring, when free from the influence of other vortices, moves rapidly forward in a straight line. It can possess, in virtue of its motion of translation, kinetic energy; it can also vibrate about its circular form, and in this way possess internal energy: and thus it affords us promising materials for explaining the phenomena of heat and radiation.

"This theory cannot be said to explain what matter is, since it postulates the existence of a fluid possessing inertia; but it proposes to explain, by means of the laws of hydrodynamics, all the properties of bodies as consequences of the motion of this fluid. It is thus, evidently, of a very much more fundamental character than any theory hitherto started: it does not, for example, like the ordinary kinetic theory of gases, assume that the atoms attract each other with a force which varies as that power of the distance which is most convenient; nor can it hope to explain any property of bodies by giving the same property to the atom. Since this theory is the only one that attempts to give any account of the mechanism of the intermolecular forces, it enables us to form much the clearest mental representation of what goes on when one atom influences another. Though the theory is not sufficiently developed for us to say whether or not it succeeds in explaining all the properties of bodies, yet, since it gives to vortex motion the greater part of the interest it possesses, I shall not scruple to examine the consequences, according to this theory, of any results I may obtain.

"The present essay is divided into four parts: the first part, which is a necessary preliminary to the others, treats of some general propositions in vortex motion, and considers at some length the theory of the single vortex ring; the second part treats of the mutual action of two vortex rings which never approach closer than a large multiple of the diameter of either; it also treats of the effect of a solid body immersed in the fluid on a vortex ring passing near it; the third part treats of knotted and linked vortices; and the fourth part contains a sketch of a vortex theory of chemical combination, and the application of the results obtained in the preceding parts to the vortex-ring theory of gases.

"It will be seen that the work is almost entirely kinematical: we start with the fact that the vortex ring always consists of the same particles of fluid (the proof of which, however, requires dynamical considerations), and we find that the rest of the work is kinematical. This is further evidence that the vortex theory of matter is of a much more fundamental character than the ordinary solid particle theory; since the mutual action of two vortex rings can be found by kinematical principles, whilst the 'clash of atoms' in the ordinary theory introduces to forces which themselves demand a theory to explain them."

The great difficulty which inheres in the vortex theory of chemical combination is to sufficiently account for what takes place at the instant of chemical union by showing that vortex atoms can, without supposing other forces than those due to their motion, have any such attractions as are known to exist, and especially to account for the enormous quantities of heat liberated in many cases of chemical decomposition.

The author, however, postpones all extended application of the vortex theory of atoms to the dynamical theory of gases for consideration in a future paper, but, among other important conclusions, states that the phenomena attending the diffusion of gases through a porous diaphragm which separates portions of gas at different temperatures will probably furnish a crucial experimental test between the vortex atom theory and the ordinary kinetic theory.

[1] *Crelle's journ.*, 1858, and translated by Tait, *Phil. mag.*, 1867.
[2] *Phil. mag.*, 1867. [3] *Edin. trans.*, 1869.

THE SILK INDUSTRY IN THE UNITED STATES.

Silk-manufacture in the United States. Compiled by WILLIAM C. WYCKOFF, special agent of the tenth census.

UNDER the above title, Mr. W. C. Wyckoff has published a volume containing his report as special agent of the census of 1880, the tenth annual report of the Silk association of America, and a directory of silk-manufacturers. The first of these reports is reprinted on account of the very small edition of the bulletin issued by the census office, and deserves more notice than it has received, on account of its admirable historical account of the numerous attempts at silk-culture in this country, and of the rise of silk-manufacture. The interest in silk-culture has steadily grown of late years, while the interest in silk-manufacture was scarcely more marked during the early struggles to establish the industry than at this present time of tariff-reform agitation.

In the work before us, the first introduction of silk-culture into America is traced back to the Spanish conquest of Mexico. Mulberry-trees were planted near the city of Mexico by order of Cortes shortly after 1522; and in 1531 a quarter of an ounce of eggs was sent on public account from Spain to Francisco de Santa Cruz, a citizen of Mexico. The eggs were reared by Auditor Diego Delgadillo with the best of success, and two ounces were returned by him to Francisco. He was accused, however, of selling the remainder of the eggs, which were the property of the crown, to others for sixty dollars an ounce, was tried and convicted. This carries the beginning of silk-culture in America nearly a century back of previous records. The industry flourished for a while in Mexico, supplying the demands of the people, and even giving rise to a certain amount of export to Peru; but, by the end of the sixteenth century, few traces of its existence were left.

Early in the seventeenth century James I. of England, jealous of the growing prosperity of silk-culture in France, resolved upon its introduction into England and the American colonies. In 1619, after one disastrous attempt had been made ten years previous, eggs were received in Virginia from the Royal gardens at Oatland; and the settlers were enjoined, by promises of aid for diligence, and threats of punishment for negligence, to undertake the culture of the worms. Meanwhile the cultivation of tobacco was discouraged in every possible way. Nevertheless, the success of the silk-industry was but slight. Some silk was grown, as it was quoted among the market-prices of commodities grown in Virginia at that time; but, in spite of all encouragement, the industry did not flourish. Calculations were made whereby it was shown that the labor of slaves employed in growing silk would produce about twice as much value as in planting sugar and tobacco; and one writer even advised the sending of all the paupers and small criminals of the old country to the colonies to engage in the culture.

In South Carolina but little more was done; and in the twenty-five years of greatest production — between 1731 and 1755 — only 251 pounds were exported. Georgia did somewhat better. In 1735 a plot of ground near Savannah was planted with mulberries and vines at the public expense. In 1744 a filature was built and bounties were offered, and from 1750 to 1772 considerable amounts of silk were exported. Then came the war of the revolution, and mention of silk-culture for a time ceases.

Mr. Wyckoff then traces the early attempts to introduce the culture into New England. In each case the culture is traced from its rise in any particular colony to its extinction, and the various causes for failure are discussed. Some new facts are added to this portion of the work; but in the main it substantially coincides with other accounts, notably with Dr. Brockett's 'Silk-industry in America' (1876), — a not surprising fact, since both authors relied upon the same library. Nevertheless, this portion of the work, covering the most interesting periods in the history of the industry in America, is thoroughly concise, and full of valuable suggestions. The growth of the industry is followed, and shown to have been steady after the revolution, with no encouragement in the way of premiums or bounties. Connecticut became the chief seat of production, and the silk was consumed mainly in the manufacture of sewing-silk. This part of the history — during the close of the last and the beginning of the present century — shows pretty plainly, that, without interference or discriminating legislation, silk-culture and silk-manufacture would develop co-ordinately. During the third and fourth decades of the present century the general interest in the subject increased; and the encouragement given by the various states and by Congress, until the Morus multicaulis furore undid them all in 1839, transcended any similar efforts since made. In 1826 we find that three-fourths of the families in Mansfield were engaged in raising silk, and made annually, per family, from five to fifty pounds, or even a hundred pounds,

of 'raw silk.' The largest amount of raw silk produced in this country in any one year is given as thirty thousand pounds, in 1841.

There is a tendency, on Mr. Wyckoff's part, to intensify the dark side of silk-culture, and to depreciate the quantity and quality of silk produced, — a tendency that is natural, and doubtless unconscious, in an agent of an association of manufacturers. In most cases he makes the amount of silk raised much smaller than given by common report: but he does so in some instances by assuming that the term 'raw silk,' or 'raw-silk balls,' in older works and reports, meant cocoons, or that there was 'neglect in discriminating between cocoons and raw silk;' also by calculating that from ten to fourteen pounds of cocoons are necessary to make a pound of reeled silk. He by no means makes it clear that the term 'raw-silk balls' really meant cocoons; as it might apply to the twisted hanks of reeled silk, and the term 'cocoons' was in use at that time. It is also certainly not justifiable to assume that the cocoons were necessarily fresh, as they are not thus handled and marketed. This he does, however, in his estimates (p. 24). Four pounds of choked cocoons to a pound of reeled silk is a liberal estimate, and would give us in 1766, when twenty thousand pounds of cocoons were produced, five thousand pounds of 'raw silk;' while the maximum amount Mr. Wyckoff allows in any one year prior to 1772 is 'rarely exceeding a thousand pounds.' While sometimes misleading, therefore, this tendency to look on the dark side of silk-production has resulted in demonstrating some exaggeration and mis-statement on the part of earlier writers; and the establishment of the truth or falsity of such statements, which have again and again been put forth, is one of the most meritorious features of the work. The most striking case in point is where (p. 25) the oft-quoted statement as to the export of ten thousand pounds of raw silk in 1759 is pretty conclusively shown to have been based upon such confusion of terms and mis-statements as above indicated.

The summing-up of the present condition (1880) of silk-culture in the United States is worthy of quotation: —

"An inquiry was attempted by the writer to ascertain the amount of raw silk raised in the United States during the census year ending June 30, 1880. It was soon determined that the expense of making such an investigation thoroughly would be more than the result could be worth. The only instances of the use of native silk in manufacture were at Williamsburg, Kan., and at Salt Lake City, Utah. The latter experiment proved financially a failure, the raw silk costing much more than the Asiatic product. It may however be stated in a general way, without pretension to accuracy, that the amount of reeled silk produced in Utah territory during the year was less than a thousand pounds; the amount in Kansas was less than five hundred pounds, and the product in no other state was more than half as much. Missouri and North Carolina probably came next in amount of cocoons raised, and after those states Pennsylvania and New Jersey, the quantities produced there and in scattered localities throughout the country being inconsiderable."

With the exception of the penchant already alluded to, in favor of the manufacturing as against the productive part of the silk-industry, the author has done his work so well that it will remain as the best monograph on the subject we possess. It is, in fact, a model report, the material for which has been gathered with care and comprehensiveness, and put together in such compact and concise form that it will serve as a cyclopaedia for all future reference, and render it extremely difficult for future writers to add any thing of consequence.

We notice but one clerical error of any importance. 'Julius Stanislaus,' in the list of authors (p. 39), should be 'Stanislas Julien.' He was a member of the French institute, and professor of Chinese literature in the College of France.

No one can read this report without feeling that the silk-manufacture of the country has been built up to its present importance by our protective policy; and at first blush this would seem to be a very strong argument in favor of that policy. But it has at the same time had the effect to throttle and destroy the production and concomitant reeling of silk. The one industry is protected at the expense of the other. 'Raw silk,' as applied in the trade, is a misnomer: it should apply to the simple fibre upon the cocoon, whereas it really applies to the reeled silk, which is as much a manufactured article as any woven or sewing goods, having gone through an elaborate process by means of special skill and complicated machinery. On its successful establishment the silk-producing industry may be said to depend. Nothing is more clearly demonstrated by Mr. Wyckoff's report than that the chief cause of failure in this last, next to no reeling at all, has been the bad reeling of domestic silk. There was never any difficulty in rearing the worms, or in getting silk of the best quality; and, when good reeling could be had, 'native silk was found to be of superior quality and strength' (p. 35). Why, therefore, it will be asked, should one kind of manufacture be protected from foreign competition, and not the other? If protection is beneficial to the people in the

one case, why not in the other? With a native food-plant (Maclura aurantiaca) now known to be available over most of our domain, with a rapidly-increasing population, with increasing means of communication, and with the settlement of sections of the country that by climate are pre-eminently adapted to silk-culture, the present period has advantages for this culture possessed at no other period, and the question is pertinent. We do not propose to introduce a homily on free trade; but we think that the chief answer that can be given to the question is, that our silk-manufactures are established, and give employment to a large number of operatives, while silk-culture as an industry amounts to so little that there is nothing to protect. The same could have been said of silk-manufacture while it was struggling for establishment, and means little more than that we must keep up a discriminating policy, simply because we have begun it; and the more powerful and wealthy the manufacturing interest becomes, the more certain will it be kept up. This is the secret, in a nutshell, of the failure of silk-culture at the present time; and the prospect for what might otherwise become a valuable productive industry is certainly gloomy.

SCRIBNER'S WHERE DID LIFE BEGIN?

Where did life begin? a brief inquiry as to the probable place of beginning and the natural courses of migration therefrom of the flora and fauna of the earth. By G. HILTON SCRIBNER. New York, *Charles Scribner's Sons*, 1883. 6+64 p. 12°.

THIS little monograph is a full summary and straightforward statement of the principal grounds of the theory of the arctic origin of the plants and animals of the northern hemisphere. These grounds, in more condensed statement, are as follows: on any planet, organic life would first appear in the region first suited for its reception. On a planet cooling from an incandescent state, the polar regions would first acquire a habitable temperature, both because their deficiency of solar heat would accelerate cooling, — that deficiency being increased by polar flattening, which renders the sun's rays more oblique, and increases the radiating surface of the polar sides, — and because, underneath the polar sides, there is less matter to be cooled than underneath the equator. On our earth the polar regions are now too cold for life, and hence they have passed through the life-sustaining stage; and this was while more equatorial regions remained too hot. As the life-sustaining isothermals moved equatorially, animals and plants migrated correspondingly. The progress of climatic change was not more favorable to this faunal and floral migration than were the southward bottom flow of water in the general oceanic circulation, and the general meridional trend of the continental and oceanic configuration, or the prevailing surface-movement in the atmospheric circulation. All these conditions oppose transmeridional migrations. Confirmatory of these deductions are numerous facts of observation, — such as similarity of the fauna and flora at all parts of the same parallel of latitude; the remains of tropical and subtropical animals and plants in arctic regions; the degenerate condition of certain arctic species, as whales, seals, and others; and the fundamental affinities of different tribes of plants and animals which testify to a common origin.

Undoubtedly some of these considerations are entirely valid, and confer upon the theory a claim to sober consideration, not to mention the authority of names previously subscribed to it. What a hesitating believer would like to know further, is, whether the inferior polar radius of the earth would really accelerate or retard polar cooling, and whether the circulations of the sea and atmosphere have been such as to promote the migrations of plants and animals from high polar to equatorial latitudes. The deductions based on progress of planetary cooling are plausible: but the queries arise, whether circulations did not exist in the fluid planet before incrustation as well as in the fluids existing after incrustation; and whether such circulation must not have maintained polar and equatorial surface temperatures so nearly equal as to permit nearly simultaneous incrustation in all latitudes; and then, whether, after general incrustation, the crustal arrest of radiation must not have speedily diminished subcrustal influence to such an extent that climate depended chiefly on solar radiation, since less than half a mile of crust would fail to conduct sufficient heat to affect surface temperature more than a small fraction of a degree. Then, on the side of inductive data, we have to consider whether the secular southward progress of identical climatic conditions would not be incompatible with that continuity of sedimentary conditions, which, especially in North America, has been traced from the thirty-fifth to the sixty-fifth degree of latitude; and whether a similar progress of identical faunal conditions would not introduce a progressive change in the correlation of life to the age of the strata, leaving the same types in older strata northward, and newer strata southward, while observation testifies that the same Hamilton types,

for instance, stretch from Missouri to Arctic America, and are enclosed in sediments of similar character throughout these limits. Aside from defects of particular arguments, and aside from any weight attributable to this essay, the question is one which will undoubtedly provoke competent and deliberate discussion. Mr. Scribner's monograph is well written, with some local diffuseness, and an occasional sentence of intolerable length, but, on the whole, a timely, suggestive, and pleasant little volume.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Rocky Mountain division. — Upon the organization of the survey, the area of the United States was divided into eight districts, in order that the progress of the work might be systematically facilitated. Of the four western districts, the 'Rocky Mountain district' includes the state of Colorado and the territories of New Mexico, Wyoming, and Montana.

Geologic work. — Colorado has been the principal field of geologic activity in the district; and the work has been carried on under the supervision of Mr. S. F. Emmons, who is the geologist in charge, with headquarters at Denver. The mining-geology of the state has been made the subject of special study, and the investigations have been confined mainly to questions of direct economic importance. Prior to 1883 the work done was principally in the Leadville and Ten-mile regions. Last season an examination of the Silver Cliff mining-district was undertaken. The geologic work was begun by Mr. Whitman Cross about the 1st of July, and was carried on through the summer, and completed in September. The topographic work had been previously completed. The preparation of the geologic map was intrusted to Messrs. Cross and Chapman, assistant geologists. Messrs. Jacob and Eakins were detailed to report on the mines and ore-deposits, under the personal supervision of Mr. Emmons. Mr. S. S. Sackett was engaged in gathering statistics as to the reduction of the ores of the district, and secured material for a chapter on the mills and reduction-works of the district.

The report on this mining-district will be of especial value, as the Silver Cliff is a mining-camp of abortive processes, a true history of which may well serve as a warning, by pointing out the errors, which there led to the failures in mining and in the reduction of the ores.

From the Silver Cliff district a short trip was made to the Sangre de Christo range, which lies on the opposite side of the valley. This was made with a view to determine the geologic relations of the Silver Cliff ore-deposits to the rocks of the range. Some field-work was also done by Mr. Cross on the mesozoic rocks exposed in the vicinity of Golden and of Morrison. In the Denver coal-basin progress was somewhat retarded by the absence of Mr. Karl, who has charge of the topographic survey of the region. Although temporarily suspended during the summer, work in this basin can be carried forward during the winter months, when the snow causes the abandonment of the field in the mountainous sections of the state. The map of the basin is to include some thirty square miles, on a scale of one mile to one inch. Information on the subject of the artesian wells in this basin is being secured, and will be embodied in the report. Voluminous rock-collections were made during the season, especially in the Silver Cliff district; and a special trip was made to Buffalo Peaks for the collection of typical specimens of hypersthene-andesite.

Besides the field-work, considerable office-work was accomplished. The notes on the Ten-mile district were worked up, and a geological map and sections of the area were made. Manuscript for the following monographs by the 'Rocky Mountian division' are in advanced stages of preparation: viz., 1°, Geology and mining industry of Leadville, by S. F. Emmons (an abstract of this paper appeared in the second annual report of the survey); 2°, Geology and mining industry of Ten mile district; 3°, Geology and mining industry of the Silver Creek district; 4°, The basaltic mesas near Golden, and their relation to the contiguous tertiary and cretaceous beds. During the season the bulletin on hypersthene-andesite, by Mr. Whitman Cross of this division, was published.

Laboratory work. — The laboratory at Denver is in charge of Mr. W. F. Hillebrand, chemist, who has been busy with the chemical and lithological examination of the rocks collected in the district, and on the ores from the various mining-districts. Some of the details of his work have already been given in *Science*. Mr. Whitman Cross has carried on the microscopical examination of the numerous thin rock-sections made of the rocks collected in the district.

Topographic work. — Mr. Anton Karl has been carrying on the topographic surveys in the district, and during the season of 1883 was in the Elk Mountains, mapping the Gunnison mining-region. His triangulation was based on Snow Mass and West Elk Mountains, two points located by the Hayden survey. These were occupied, and a system of triangulation was extended from them over the whole area surveyed. The principal mines in the Ruby basin, lying between Mount Owen and Irwin Peak, were all located, as well as Anthracite Mountain and the property of the Denver and South Park coal company. Topographical data were obtained for

mapping the Ruby and Irwin regions preliminary to future geologic work. The country lying between Beckwith, Marcellina, and Anthracite Mountains was also worked up, and each of those points occupied, and the valley of Ohio Creek surveyed. In the early part of September, work was begun in Poverty and Washington gulches and in Baxter basin, and the East River valley, between Schofield, Gothic, and Crested Buttes. Fair results were obtained, although severe snow-storms impeded progress. About the middle of the month Mr. Karl was directed to coöperate with special agent J. A. Bently, of the Interior department, to ascertain the accuracy of the Land-office survey of the Maxwell grant in southern Colorado and northern New Mexico. He was occupied on this work the remainder of the season, and in the latter part of November presented to the court a map prepared by him in support of his evidence.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Chemical society, Washington.

Feb. 28. —Mr. W. H. Seaman exhibited and described a new form of burette, and also a graduated pipette, modelled after the ordinary medicine-dropper. —— Prof. F. W. Clarke exhibited a copy of Lothar Meyer's curve of atomic volumes, drawn to large scale, with the most recent data. With it, upon the same sheet, was compared a similar curve of melting-point.

Biological society, Washington.

Feb. 23. — Dr. Elliott Coues read a paper on the present state of North-American ornithology. In discussing the precontemporaneous history of the subject, he defined the following epochs: 1, The archaic (prior to 1700); 2, The pre-Linnean (1700–50); 3, The post-Linnean (1750–1800); 4, The Wilsonian (1800–25); 5, The Audubonian (1825–50); and, 6, The Bairdian (1850+). A number of periods were also defined as follows: 1. The Lawsonian (1700–30); 2. The Catesbian (1730–48); 3. The Edwardsian (1748–58); 4. The Linnean (1758–66); 5. The Fosterian (1766–85); 6. The Pennantian (1785–90); 7. The Bartramian (1790–99); 8. The Vieillotian (1800–1808); 9. The Wilsonian (1808–24); 10. The Bonapartian (1824–31); 11. The Richardsonio-Swainsonian (1831–32); 12. The Nuttallian (1832–34); 13. The Audubonian (1834–53); 14. The Cassinian (1853–58); 15. The Bairdian. The establishment of the American ornithologists' union, he thought, would probably mark the establishment of a new epoch, — one in which the existing intricacies of ornithological nomenclature will be replaced by a consistent system founded upon a rational code: the present is simply a period of transition. Dr. Coues laid before the society the plate proofs of the forthcoming new edition of his Key to North-American ornithology.

Mr. C. D. Walcott exhibited a second time the rocks from Maine, containing fossil corals. He stated, that having received a number of additional specimens of the granite-like rock containing fossils, Stromatopora, corals, plates of crinoid stems, etc., from Litchfield, Me., he found that he had been incorrect in calling the rock a granite, as it was of sedimentary origin, — a clastic rock, so changed in the specimens examined that it might be called a conglomerate gneiss.

Prof. Lester F. Ward exhibited a specimen of the 'diamond willow,' — a variety of Salix cordata occurring in the upper Missouri region, distinguished by a great exaggeration of the scars left by the early growths of limbs which form series of large diamond-shaped cavities along the stems. He also exhibited some canes carved by the people of that region, which show the so-called diamonds in a striking manner. Professor Seaman advanced the theory that these scars are caused by the influence of some fungus or of some insect which lays its eggs in the buds.

Linnaean society, New York.

Feb. 8. — The publication of vol. ii. of the Transactions was ordered. —— Dr. C. Hart Merriam read a biography of the muskrat (Ondatra zibethicus), giving its life-history as noted by him in the Adirondack region of north-eastern New York. The paper was followed by a general discussion as to its differing habits in a less boreal locality. —— A translation from the Spanish of Rafael Montes de Oca by L. S. Foster, and the subsequent discussion, developed many interesting facts concerning the Trochilidae. —— Mr. William Dutcher remarked upon the scarcity of the snowy owl (Nyctea scandiaca) this winter on Long Island, and upon the presence in considerable numbers of the thick-billed guillemot (Lomvia arra), as well as the razor-billed auk (Utamania torda); while not a single sea-dove (Alle nigricans) had come under his observation. His Long Island records for the Ipswich sparrow (Passerculus princeps) give the capture of thirty-three specimens since their arrival, Dec. 16, after a severe snow-storm.

Academy of natural sciences, Philadelphia.

Jan. 22. — Mr. F. W. Putnam made a communication on a group of mounds occurring on the Miami River, which in many respects he considered the most important in the country. The methods of investigation, and the objects found in the mounds referred to, were described in detail, and illustrated by means of specimens and photographs. While no doubt exists as to the construction of mounds by some of our existing Indians, those he described had absolutely nothing in common with the more modern structures, except in so far as they indicated the Mongoloid type.

As the essentially fresh-water character of the worm Manayunkia speciosa (the forms related to

which are all marine) had not heretofore been unquestionably established, Mr. Edward Potts believed that it would be of interest to record that he had in his possession specimens from the Schuylkill River above the dam, and therefore from absolutely fresh water. The currents produced by the cilia on the tentacles were claimed to be excurrent, and not incurrent, as might have been expected, the feeding processes in some cases being performed by the tentacles themselves.

Jan. 29. — Prof. J. Leidy directed attention to a collection of fossil bones which had been submitted to his examination by the Smithsonian institution. They were obtained at the mine of the American salt company, near New Iberia, La. They chiefly consist of remains of Mastodon americanus, of Equus major, of an Equus not distinguishable from the domestic horse, and of Mylodon Harlani. Of the Mastodon, the collection contained well-preserved molar teeth, and characteristic fragments of bones. Of the Equus major, there are vertebrae, fragments of long bones, and a number of teeth. Of Mylodon, there are several molar teeth, vertebrae, and other bones, mostly fragments. Among these are two mature and well-preserved tibiae, the best specimens yet discovered of the species. They are identical in form and size with those of M. robustus, indicating M. Harlani to have been a species of the same size as the former.

Prof. J. Leidy stated that he had recently received for examination, from Mr. B. W. Thomas of Chicago, several glass slides with mounted specimens of sand. These were obtained by washing clay from the bowlder drift of Meeker county, Minn. In the specimens Professor Leidy recognized some well-preserved and characteristic foraminifera, of which two forms appeared identical with Sextularia globulosa and Rotalia globulosa, now living in the Atlantic Ocean. The fossils Mr. Thomas supposes to be derived from a soft yellow rock, cretaceous shale and lignite forming part of the drift. He also reports the finding of fragments of marine diatoms in the clay. Professor Heilprin suggested that the foraminifera referred to had probably been washed from underlying Silurian rocks.

Feb. 5. — A communication was read from Miss S. G. Foulke, describing a new species of rotifer under the name Apsilus bipera. The specimens were found in Fairmount Park; and, in common with all members of the genus, they possess, instead of rotatory organs, a membranous cup or net, which is used for the capture of food. The specific distinction of the form now described consists chiefly in the structure of the net, the presence of a true stomach in addition to the usual crop, and the presence of cilia inside the net. It was proposed to unite the forms Apsilus lentiformis Meczinchoff, Dictyophora vorax Leidy, Cupelopagus lucinedax Forbes, and the species now described, under one genus, Apsilus, in consequence of their strong points of resemblance. These are, briefly, the presence of two eye-spots, of a membranous crop instead of rotatory organs, of a mastax exactly alike in all, and the absence of a tail or foot-stalk.

Prof. H. Carvill Lewis announced the discovery of fossils in the triassic red shale from the neighborhood of Phoenixville, and gave a preliminary notice of them. They occurred in soft red rock at the southern entrance to the new tunnel, in strata dipping 10° N. 30° W., which would place the bed considerably below the strata of the old tunnel, perhaps a thousand feet, unless faults intervened. The specimens consist of some five distinct species of lamellibranch shells, a ganoid fish, some plants, and a doubtful fragment of a saurian bone. Among the shells are two species of Unio, somewhat resembling U. calceolus and U. lanceolatus of Lea. These are, of course, of fresh-water origin, and are found in single and double valves, and open. Three species of marine shells also occur in the collection; and the apparent commingling of fresh-water and marine species was referred to as an interesting fact. The shells, which in most instances lay parallel with the bedding, were frequently distorted by the movement of the shale. The Unios were regarded as probably the most ancient yet discovered, some specimens found in New Mexico being of later age. The coal-plants represented are fresh-water species, but reference was made to a triassic marine fucoid described by the speaker some years ago. The fish belongs to the lepidoganoids, and resembles the Catopteris gracilis of Redfield.

Engineers' club, Philadelphia.

Jan. 19. — Mr. Wilfred Lewis read a paper upon the resilience of steel, reviewing some of the means employed for the storage of energy, and showing the place occupied by steel among them. Among the means now employed, compressed air, hot water, and the storage battery were cited from an English writer as being about equal in value, and as giving out about 6,500 foot-pounds of work per pound of material used. Steel springs, according to the same writer, were said to yield about 18 foot-pounds per pound. In this connection, the project of using steel springs as a motor for street-cars was referred to as the most hopeless of all possible means of locomotion. To test the accuracy of this statement in regard to steel, several experiments were made by the writer upon tempered specimens, both for tension and flexure. Contrary to expectation, the highest results were shown by the flexure of a small spiral clock-spring weighing 2,040 grains, which gave out, when wound up, about 45 foot-pounds of energy; or, in other words, 154 foot-pounds per pound. The transverse strength of this steel, within the elastic limit, was found to be about 300,000 pounds per square inch, and its modulus of elasticity about 30,000,000. Such extraordinary strength, with such a low modulus, was so far beyond conjecture, that it seemed to give a new hope for the success of the project referred to; but, after making the necessary allowances for weight of car and efficiency of driving mechanism, it was found that not more than about 20 foot-pounds per pound of car would be available for locomotion. It was therefore improbable that such a car could ascend a hill over twenty feet high. It was also a matter of

doubt, whether larger springs could be made to show results which would even approach these figures; and on this account the experiments about to be tried might be looked for with some interest. —— Mr. H. C. Lüders exhibited specimen of rolled and annealed phosphor-bronze of maximum ductility, and consequently of minimum tensile strength, and submitted the following data of the test thereof: length, 2″; diameter, 0.57″; subjected to a strain of 13,620 pounds, equivalent to 53,400 pounds per square inch; elongation, 70.5 %; reduced area at point where fracture would occur, 0.3″; elastic limit, about 18,000 pounds per square inch. Hard-rolled rods, tested without turning off the surface, have shown a tenacity exceeding 90,000 pounds per square inch. —— Mr. Howard Murphy presented for Mr. Louis C. Madeira, jun., the Record of American and foreign shipping, containing an interesting set of drawings for the details of construction of iron ships. —— Mr. Percival Roberts, jun., gave some account of the results of experiments, now being conducted by Mr. James Christie at Pencoyd, upon the relative elasticity of iron and steel structural shapes.

NOTES AND NEWS.

WE noticed a fortnight ago the presentation of the Lyell medal of the Geological society of London to Professor Leidy; and we now learn that the council of the society at the same time awarded to Mr. Leo Lesquereux the sum of twenty pounds sterling from their Barlow Jameson fund, in recognition of the value of his services to geological science. The great extent and value of Mr. Lesquereux's contributions to our knowledge of the fossil flora of North America are well known, and will be still better appreciated when his volume on the tertiary plants, now completed, but not yet distributed, shall be issued.

— Any contributions that American biologists may feel disposed to make toward the Hermann Müller foundation, referred to in our last issue, can be sent direct to the treasurer of the committee, Wilhelm Thurmann, Lippstadt, Germany, or they will be receipted for and forwarded by Professor William Trelease, Madison, Wis.

— The death (March 2) is announced of Isaac Todhunter, whose name has been a terror to the average college-student of the present generation. He was born at Rye in 1820, and was senior wrangler in 1848. A large portion of his energy was devoted to the production of the invaluable mathematical text-books and treatises which are so well known.

— Capt. Bernard, in the course of a journey into the far interior of Algeria, twenty kilometres north of the Bou Saada River, found a singular flat-topped butte whose elongated rocky summit rises sixty-five feet vertically from the talus which crowns its sloping base. This place, called by the Algerians 'El Gueliaa,' forms a rocky table one hundred and seventy-five feet wide by six hundred feet long, reached by a stairway cut on the northern side. On this plateau has been erected a structure, still in a remarkable state of preservation, and, from the nature of its materials, apparently of Roman origin. On the east is a large rectangular stone building, containing eight or ten apartments opening upon an inner court. North of this building a vaulted cistern is dug in the rock: sixty feet to the west are two others, side by side, one vaulted over, and the second open to the sky. It is very difficult to say how these cisterns were filled, as there are no springs, or traces of wells, in the vicinity. It was evidently a post established for some special purpose. At Mesaad oasis a hillock thirty or thirty-five feet high bears the broken remains of a Roman gate. The Arabs have tunnelled or ditched the hillock for brick-clay; showing, that beneath the Roman remains now so long abandoned, and over the beds of chalk, salty earth, and clay, which form the mound, there are abundant remains of an earlier occupation, apparently for a considerable period, by a race whose stone weapons and tools, fragments of stone and ivory, and other rejectamenta, are their only memorial.

— The expedition charged by Russia with the task of exploring the ancient bed of the Oxus has concluded its work. The former path of the stream has been subjected to careful levelling from Khiva to the Caspian; proving that it is possible to turn the river into its old course only at the expense of a canal two hundred kilometres long, which is equivalent to a permanently adverse decision on its practicability.

— Signor F. P. Moreno, director of the anthropological museum of Buenos Ayres, was authorized in 1882 to undertake a journey into the interior of Bolivia for purposes of anthropological study. He now reports having visited the provinces of Cordoba, San Luis, and Mendoza as far as the slope of the Andes. During a year's travel he has studied the modern, as well as the traces of the former, inhabitants, and has exhumed in many places bones, weapons, inscriptions, and relics of burials, and has made plans and photographs of the remains of ancient villages. He believes he has obtained full material for a study of life in these regions before the Spanish conquest. He visited the whole extent of the so-called road of the Incas to the Uspallata Pass, when compelled to return by the advent of winter, and has pretty thoroughly explored the range of the same name.

— The material accumulated by the Krause brothers in Alaska, 1881–82, is being rapidly worked up. In the *Botanisches centralblatt* (Cassel, 1883, Nos. 41-43) Karl Müller publishes an account of the mosses of the Chukchi peninsula. He finds twenty-eight new out of seventy-five species collected, certainly a rather unusually large proportion. One of these, a cleistocarpous form allied to Voitia, is erected into a new genus by the name of Krauseella.

Dr. Hartlaub, in Cabanis's journal, enumerates the birds obtained at the head of Lynn Canal, near the mouth of the Chilkat River, S. E. Alaska. Lagopus leucurus, Certhia familiaris, Dendroica Townsendi, Sialia arctica, Chrysomitris pinus, Sphyropicus ruber, and Tinnunculus sparverius are noted as new to the region, though several of them may be only occa-

sional stragglers. The last mentioned has been observed on the Aleutian Islands.

In a late number of the *Deutsche geographische blätter*, Dr. Arthur Krause gives an interesting account of the houses of the T'linkit Indians, their methods of building, tools used, and modes of ornamentation. Iron was found at a very early date in the possession of the natives, but was without doubt procured by them from the Russian and Hudson Bay traders by a long but rapidly executed series of transfers from one band or tribe to another. In one year measles penetrated from British Columbia to Fort Yukon and beyond, and trade would take little longer.

Dr. Arzruni has reported on the minerals of the expedition in a paper read before the Gesellschaft für vaterländische kultur in Breslau. The rocks from widely separated portions of the territory indicated analogous geological structure, being chiefly of the oldest crystalline formations, — rocks belonging to the granite series, crystalline schists, and late tertiary volcanic ejections. Remarkable garnets were obtained from Fort Wrangell, and various gold ores from near Sitka.

— The Natural science association of Portland, Ore., has secured new quarters, and hopes soon to establish yearly courses of lectures. The annual address was given Feb. 6, by Prof. L. F. Henderson.

— Dr. D. G. Brinton, the well-known archeologist, has been elected professor of ethnology and archeology by the council of the Academy of natural sciences of Philadelphia, and is making arrangements for the delivery of a course of lectures on his specialty in connection with the department of instruction of the academy during the coming spring.

— Four scientific conventions are to be held in Washington in May, — that of the American medical association, the American surgical association, the American climatological association, and the American fish cultural association.

— The success of the borings for artesian wells at Denver, Col., seems to have encouraged the people of Montana to experiment in the same direction. A boring at Miles City, Montana Territory, on the Yellowstone River, struck flowing water at a depth of three hundred and forty-one feet. An analysis of the water proves it to contain more than sixty grains of carbonate of soda to the gallon. A second well has reached the depth of three hundred and twenty-one feet, without a flow of water. At Billings, nearly a hundred and fifty miles farther up the Yellowstone, a boring has been carried to a depth of nine hundred feet without success, but will be carried still farther down. At Helena, also, a well is being sunk; but work has been postponed until spring.

— Prof. W. Kitchen Parker gave the first of a course of nine lectures on mammalian descent, at the College of surgeons on Feb. 4. His remarks were of an introductory character, and were intended to aid the listener in comprehending the substance of the subsequent lectures. The subject of descent was viewed from an embryological and purely evolutional standpoint. The classification of the mammalia employed is that now generally in vogue among mammalogists, the class being divided into Prototheria, Metatheria, and Eutheria. It is to the consideration of the first and second of these sub-classes, and to the Ineducabilia among the Eutheria, that the majority of the lectures will be devoted. The lecturer expressed his belief in the former existence of a group of generalized forms, such as Huxley has described under the name of Hypotheria. Professor Parker's style is simple and pleasing, and, in the introductory lecture, highly poetical. His sentences are replete with biblical allusions, some of which border on the comical. He described the Metatheria, for example, as looking from the summit of their Pisgah toward the promised land of the Eutheria, into which they were never to enter.

— Mr. W. F. Denning was led to conclude, from certain markings discerned on the planet Mercury in the mornings of November, 1882, that its rotation-period is not accurately given in the text-books; the period of twenty-four hours derived from the observations of Schroeter and Harding, about the beginning of the present century, being apparently about one hour too short. His suspicion is now confirmed by a communication from Signor Schiaparelli, who has been very successful during the last two years in observing definite markings on Mercury, and who pronounces the planet's period of rotation, as usually given, 'very far from the truth.' His forthcoming memoir on Mercury is expected to give some very interesting details of the physical aspect of this planet. The necessarily unfavorable circumstances attending all observations of Mercury, make it not to be wondered at that little or nothing is known of its surface-phenomena; but Mr. Denning regards it as obvious that the markings are of a fairly distinct character, and likely to prove a fruitful subject for further investigation. He remarks that the general aspect of the disk, as seen in November, 1882, reminded him forcibly of Mars; and the definite nature of the spots may therefore be readily imagined. He thinks the dark spots and shadings may be regarded as fairly permanent, while the white spots are influenced by rapid variations.

— The following, from *Nature*, will interest our readers: —

On Tuesday afternoon [Feb. 5] at Oxford, convocation witnessed in the Sheldonian theatre the most exciting scene that has been enacted in the university since the opposition to Dean Stanley as select preacher. Last summer convocation passed by a small majority a vote of ten thousand pounds for a new physiological laboratory. The vote was opposed by the anti-vivisectionists, and by some on the ground of economy. A memorial got up by Mr. Nicholson against vivisection having produced no effect on the council, the opponents of Professor Burdon Sanderson determined to oppose the decree brought before convocation on Tuesday for empowering the sale of stocks for the ten thousand pounds voted last

June. The decree was supported by the dean of Christ church, Dr. Acland, and the warden of Keble, and was opposed by Professor Freeman and Mr. Nicholson. After a stormy debate, the vote was carried by a hundred and eighty-eight votes against a hundred and forty-seven. The result was received with enthusiasm, and Oxford is to be congratulated on it. To what shifts Dr. Sanderson's opponents were put may be seen from what the *Times* calls 'the most astonishing speech' of Mr. Freeman the historian, "who afforded a curious example of the confusion of thought into which even intelligent men may be led by an over-indulgence in sentiment. It would be as reasonable, said Mr. Freeman, for the historian to illustrate the festivities of Kenilworth by an actual bull-baiting, as for the physiologist to experiment upon living animals. Mr. Freeman, in his zeal to establish the scientific character of the historian, forgets the difference between description and discovery, and ignores the fact that the physiologist, at least under the existing law, makes his experiments, not for the instruction of pupils, but with a view to discover what is as yet unknown. A more curious article in the indictment against vivisection we have not met with since the celebrated letter in which Sir George Duckett told the royal commission that he had no evidence to give, but that he considered vivisection 'an abomination introduced from the continent, going hand in hand with atheism.'" The *Times*, in its leader on the subject, treats it sensibly and moderately. "All those who are open to argument have been long ago convinced that Science cannot proceed on her beneficent way without the aid of experiments, some of which must be painful; and those who are not open to argument, and those who believe, like some of the wiseacres whose opinion is on record, that 'medical science has arrived probably at its extreme limits,' are not likely to be convinced by any thing that can be said or by any facts that can be brought against them. Parliament, on the recommendation of one of the strongest royal commissions ever appointed, has legislated in the matter, and physiological experiment is now under limitations as severe as it is possible for it to be consistently with any kind of progress in discovery. Abuses are of the rarest occurrence. Men like Dr. Sanderson are not only humane, but they are conscious that public opinion is awake on the matter; and their discretion as to what should be done, and what should not, is absolutely to be trusted. It is to be hoped that the sensible action of convocation will not only encourage the Waynflete professor to proceed as his scientific conscience may guide him, but will convince the well-meaning but irrational opponents of scientific freedom that further action on their part would be not only vexatious, but unsuccessful."

— Professor Nehring has reported to the Berlin anthropological society the discovery, in a cave near the village of Holzon in Brunswick, of bones which show proofs of cannibal practices. It is the first evidence discovered, that a race of anthropophagi ever existed in Germany. The bones were not fully calcined, and had evidently been chopped to obtain the marrow. As a still greater proof of cannibalism, it was shown that the bones were thrown in a heap, as if cleared after a meal. Other objects of interest, such as rough bronze ornaments, were found in the cave; and, on excavating a lower stratum of the floor, bones of animals of the glacial period were found, showing the existence of the cave at that time. In the subsequent discussion, Professor Virchow raised some objections to the cannibal theory.

— A society with Dr. C. F. Millspaugh as president has been formed at Binghampton, N.Y., under the title of the Erosophian microscopical society. It has some forty or fifty members.

— *Papilio*, on its removal to Philadelphia, no longer appears as 'the organ of the New York entomological club;' but in other respects it does not differ noticeably, as the new editor, Mr. Aaron, has evidently endeavored to preserve the character of the journal, even to typographical details. As is fitting, considering its name, it is still 'devoted exclusively to Lepidoptera,' and renders the lovers of those insects good service.

— A memorial volume of the scientific papers of the late W. A. Forbes, at the time of his death prosector of the Zoölogical society of London, is to be published, through a committee consisting of Professors Flower and Bell, and Messrs. Johnston, Mivart, and Sclater, at the price of one guinea. Mr. Sclater will edit the volume, Mr. Johnston will add a biography, and Mr. F. Jeffrey Bell (5 Radnor Place, Gloucester Square, London) will act as secretary and treasurer.

— In his presidential address before the Biological society of Washington, on "Certain phases in the geological history of the North-American continent, biologically considered," Dr. C. A. White shows how important to a knowledge of the evolution of the continent is a study of terrestrial and fresh-water faunas and floras of geological times.

— Dr. C. B. Reichert, for many years director of the anatomical museum at Berlin, died in that city, Dec. 21, 1883.

— Prof. H. Carvill Lewis, A.M., recently appointed lecturer on geology and paleontology at Haverford college, gave his first lecture last week Wednesday, upon 'The foundation-stones of Pennsylvania.' This week's subject was 'The ancient life-history of the Chester valley;' and in following weeks 'The origin of the Pennsylvania mountains,' 'Volcanic action in Chester and Montgomery counties,' 'The geology of Haverford and its vicinity,' 'The glacial epoch in Pennsylvania,' will be treated. The lectures are open to the public.

— The seventh Saturday lecture in the National museum was on Feb. 16, by Prof. E. D. Cope, on the 'Origin of human physiognomy and character,' — a discourse the main features of which have already been published in the *American naturalist*. On Feb. 23 Mr. John Murdock, late of the signal-service party at the Oglaamie station, North Alaska, gave a very vivid account of 'Eskimo life at Point Barrow.'

GRANITE FALLS, A SCENE IN THE INNER GORGE OF KAIBAB DISTRICT, GRAND CAÑON OF THE COLORADO.

SCIENCE.

FRIDAY, MARCH 14, 1884.

COMMENT AND CRITICISM.

If one wishes to study man, it may be desirable to seek large cities, where men abound in great numbers and in almost infinite variety; but, if nature is to be questioned and cross-examined, it is wise to betake one's self to the fields, the woods, and the mountains, over which the artificial has not yet gained control. In the study of various problems in terrestrial physics, it is of the utmost importance to place the observing-stations so that they may fairly represent general conditions, and not be influenced by merely local disturbances; and it has long been customary to give such considerations proper weight in the selection of points at which various physical constants are to be determined. An article in the present issue, on the exposure of thermometers, furnishes evidence that it is quite possible for large cities to be fortunate in the possession of a climate which is largely artificial; that a meteorology which is based on observations taken under such artificial or peculiar conditions is likely, now and then, to go astray; and that in physics, as in politics, it is sometimes safe to await 'returns from the country.'

If the earth be represented by a globe sixteen inches in diameter, the largest city in the world will hardly be visible to the naked eye; and yet in most large cities there will be found to exist a set of meteorological conditions differing considerably from those of the surrounding country. It is not likely that difference exists alone in temperature, or that it is not noticeable, and worthy of serious attention, in other elements which go to make up 'the weather;' and it would appear desirable for working-meteorologists to agree upon some systematic plan of investigation which might result in the determination of the proper location and exposure of their instruments, that they may more truthfully exhibit the average condition of the area which they represent.

The close connection and interaction of religion, statescraft, and science in the modern world is illustrated in an interesting way in a recent number of the *Proceedings of the Royal society of London*. The British government, desiring to introduce cheese-making as an Indian industry, was met by the difficulty that the religious beliefs of a large portion of the population of India placed an absolute veto on the use by them of cheese, in the manufacture of which rennet obtained from the stomach of an animal had been employed. The leaves of a species of Pinguicula are used by the Laps to coagulate reindeer-milk; and the government circulated in India a request for information as to any Indian plant which was known to have a similar property. Surgeon-Major Aitchison called attention to Withania coagulans, a Himalayan and northern India plant, the seeds of which were said to coagulate milk. A quantity of this material was sent from Kew to Mr. Sheridan Lea of Cambridge for examination. He was able to extract from it a ferment identical with the rennet ferment of the gastric mucous membrane of animals, and capable of preservation in solution as a commercial article in a similar way. The ferment exists in the seeds in considerable quantity, and is readily and cheaply extracted from them.

Of the 'change in the unit of time' controversy, to which we alluded in a late issue, there seems as yet no likelihood of abatement. Originally begun by Mr. Stone, lately her Majesty's astronomer at the Cape of Good Hope, it was at once participated in by Sir George Airy, the late astronomer royal, by Professor Newcomb, and later by a number of continental astronomers. When the Royal astronomi-

cal society met last autumn, Mr. Christie, the present astronomer royal, declared the subject "pretty well thrashed out, and quite unsuitable for discussion at their meetings." Since that time, both sides have had important accessions; no less a person than Col. Tennant, of her Majesty's mint, Calcutta, taking essentially the same view with Mr. Stone, and Professors Cayley and Adams coming forward with the clearest of proof that no such deviations as those indicated by Mr. Stone exist.

At first blush, it will seem very improbable that an astronomer of Mr. Stone's well-earned reputation for acuteness should get muddled in a matter of fundamental astronomy involving only simple algebra; but when he finds himself unable to clarify, after a half-dozen astronomers more able than himself have been endeavoring for six months to convince him of his fallacy, it can scarcely be called rash heterodoxy to suggest that an error on the part of his opponents may be at least among the possibilities. Although he is now aware that it may appear useless to continue researches of which the fundamental principle is disputed by astronomers of note, his latest utterance is, "I have not seen at present any evidence which weakens in the slightest degree my confidence in the accuracy of my results." It is very difficult for the non-mathematical to recognize the possibility of a mathematical dispute, even when the terms involved are of slight importance; but no sort of excuse can appear for a difference regarding a supposed discrepancy of this magnitude, involving the early disruption of fundamental tables of the celestial motions. Unless, then, this matter admits of speedy and permanent decision, the one way or the other, with the entire agreement of all parties to the controversy, astronomy would appear to run the serious risk of forfeiting her claim to a place among the exact sciences.

ONE of the indications of the activity in chemical matters in Germany may be found in the great prosperity of the Berlin chemical society. This organization dates only from the year 1868, when it was started under the auspices of the Berlin chemists, headed by the genial Hofmann. In that year the volume containing the articles communicated to the society numbered only about two hundred and eighty pages. In a short time the society became a national instead of a local affair, fully deserving the name, '*Deutsche chemische gesellschaft*,' given to it at the outset. According to the last annual report, the number of members is now nearly three thousand; an increase of about two hundred having been made during the past year. The last annual volume published by the society numbers over three thousand pages. Of the members, eight hundred and forty-eight are foreigners; the largest number (one hundred and eighty-four) of these being English, while there are one hundred and forty-five Americans; and one hundred and forty-four Swiss, on the list. It will be seen that more than two-thirds, or about two thousand, of the members, are Germans.

It would lead too far to discuss fully the causes of the activity thus indicated. One of the most potent direct causes is, no doubt, the close bond of connection that has been established in Germany between pure chemistry and its industrial applications. While there is, perhaps, no country in which the maxim 'Science for the sake of science' is more frequently heard or more firmly believed in than in Germany, it is equally true that in this same country the most successful applications of the truths established by the votaries of pure chemistry have been made. Industries are there springing up every year, founded directly upon the most recent discoveries made in the university laboratories. Large numbers of thoroughly trained chemists are employed in the new factories. The value of science in carrying on industrial operations is fully recognized. It is certainly instructive to note that this state of things has been brought about by devotion to pure science. The much talked of 'practical man' who wants 'none of your theories' is not a common phenomenon in Germany.

THE notice in another column, of the pamphlet by Mr. Frank B. Scott, calls attention to a class of publications which belong to the idiosyncrasies of scientific writings. The law of variation among men involves the occasional occurrence of an extreme departure in any given direction from the normal average; and it is quite in accordance therewith that there should be from time to time a writer who seriously propounds startling views on a scientific subject about which he is ignorant. Such a person is one who is both very inexperienced and thoroughly unpractical, yet perhaps really intelligent. Something arrests his attention. He begins thinking about it, and finds a series of superficial or casual resemblances, which leads to a grand general conception. Startled and delighted, he eagerly hunts up some text-book: it contains no hint of the grand conception. The thought is then new. With feverish excitement, a few facts are patched together out of a fragmentary and too often inaccurate knowledge, and the idea is confirmed. The theory is then given to the world, condemned by the critics, laughed over as a choice bit by a few, and then forgotten according to its deserts. Fortunate is the author if he gains in experience what he does not secure in fame.

ATTENTION has recently been called to the bill for the establishment of 'national experiment-stations,' now pending before Congress, by a circular sent out by President S. A. Knapp of the Iowa agricultural college, who is the chairman of a committee appointed in January, 1883, by the U. S. department of agriculture, to have the matter in charge. The most interesting portion of the circular is, of course, the text of the bill. This provides for the establishment, at every agricultural college which possesses an improved farm, of a 'national experiment-station.' These stations are to be under the general control of the regents or trustees of the colleges where they are located; and the general character of the work to be done at each station is to be determined by the U. S. commissioner of agriculture, the president of the college, and the director or superintendent of the station. The sum of fifteen thousand dollars is to be appropriated to each such station, but only so much of this sum is to be paid over to the station as will cover expenditures actually incurred.

The objects aimed at in this bill appear to be twofold, — first, to promote the advance of a scientific knowledge of agriculture; and, second, to unify to a certain extent the work of investigation now carried on at scattered and independent centres. To the first of these objects it would seem that no one could take exception. If it be admitted to be within the province of the national government to aid at all the advancement of science, it would certainly seem that a branch of applied science which touches the every-day interests of fully half our people, and which deals with a calling which is one of the chief sources of our national wealth, might reasonably claim a portion of that bounty which is so freely extended to other sciences, especially since the experience of Europe, and of several states in this country, has abundantly demonstrated the great utility of such stations. Certainly such an expenditure of the public money is at least as legitimate as river and harbor appropriations or arrears of pensions acts.

As regards the second object of the bill, while it may be desirable, it is not so certain that it can be readily attained. It may be lamentable, but it certainly is a fact, that scientific men do not work well in harness, and are apt to entertain extreme ideas of the value of personal independence in their work. Much would depend upon the character of the commissioner of agriculture. No man fit for the position of director of an experiment-station would be likely to consent to conduct that station according to a plan laid out in Washington. On the other hand, if the commissioner were a man whose personal character and scientific attainments commanded respect, he would have an opportunity which, if judiciously used, could not fail to bring honor to him, and profit to the interests of agriculture.

Should the bill pass, it is not impossible that one of its benefits might be, that it would render more difficult the appointment to the responsible post of commissioner of agriculture of individuals such as some who have in the past held without filling that position.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Red sunsets and precipitation.

THE readers of the scientific journals have, no doubt, observed that the prevailing explanation for the red sunsets and colored sky during the past few months is that of chromatic diffusion of light by volcanic-ash particles. There are some apparent incongruities as pointed out by Mr. Proctor and others; but we believe that the established physical laws will permit a satisfactory solution of the phenomena, assuming volcanic matter as the cause.

The object of this letter is to notice what seems to the writer a probable connection between the conspicuous sunset colors and the excessive cloudiness and precipitation during the last month or six weeks. With regard to precipitation we must recognize Professor Aitken's discovery; viz., that clouds and all forms of precipitation occur by virtue of the solid particles of matter suspended in the atmosphere, serving as nuclei upon which the aqueous vapor is condensed. The supply of this solid matter in the aggregate is nearly uniform; but, if an excess occur from any cause, we should expect a larger precipitation for the same hygroscopic state of the atmosphere. This conclusion, we believe, has been verified during the past two months, in meteorological observations. It might be argued that the cloudiness and rain have not been evenly distributed, as would be expected if caused by the settling of the ash-particles; but in what has been said, no regard is taken of the various causes for an unequal distribution of the matter, and the common conditions of storms. We should expect weather-records to show the greater precipitation in regions where the sky colors have been most conspicuous. The writer, however, has no data for verifying this.

The above is advanced rather as a suggestion than as an exposition, in the hope that it may stimulate a more exhaustive study of this connection, if such there is. W. H. HOWARD.

Does Unio spin a byssus?

Attached to the female of a Unio which I collected, last August, from the middle fork of the Holston River, at Marion, Va., were stones, some of them more than an inch in diameter. So strongly were these attached that not only could they be lifted from the water by the attachment, but it took considerable force to separate them from the Unio. I had often seen Unio shells covered with gravel and mud firmly cemented by the Confervae that commonly grow upon the anterior portion of the valves exposed above the water; but these shells under consideration were unusually free from such growths. At the time, I removed the pebbles without giving attention to the phenomenon; but, recurring to it afterwards, I found, on examination, what appeared to be *the bases of byssi*, situated at about the middle of the anterior fourth of each valve.

Again: these were only found on females, all of which were gravid, having the eggs well developed. Is it a provision to prevent the strong current of this river from sweeping them into unsuitable spawning-grounds while depositing their eggs? Are these byssi (?) *seasonal*, or *permanent?* If byssi, how are they spun? E. P. LARKIN.

Retrograde metamorphosis of a strawberry-flower.

Mr. J. H. Foster of Orange county, Fla., sends a monstrous form of a strawberry-blossom, which is shown in the accompanying engraving. During the winter there were several hard frosts which blasted many of the strawberry-flowers in Florida. This injurious weather may have been the cause of the strange malformation. The engraving shows the flower-stalk,

a, raised from its reclining position. The calyx-lobes are at *b*, *b*, *b*, and within these is a circle of stamens. In place of the fleshy receptacle, so much relished by all when ripe, there is a small strawberry-plant, *c*, with its short stem, and a root, *d*, springing from near its base. This root, doubtless, penetrated the soil soon after it started out from the stem, and became a source of nourishment for the young plant. The base of the stem has many undeveloped pistils scattered over its surface, which plainly show that the plant is a transformed receptacle. The young leaves, when unfolded, are of the normal form, consisting of three wedge-shaped, coarsely serrated leaflets.

Flowers, and in fact all organs of plants, have been known to undergo strange changes of form. All gradations may be found, from one set of floral organs to another. This is seen between petals and stamens in almost every white water-lily, and between stamens and pistils in willow, apple, poppy, and other blossoms. Stamens are changed into, or become, petals in the familiar process of the 'doubling' of flowers. This tendency to retrograde is carried still farther when both the stamens and pistils become green, leafy expansions, and thus reveal their true nature. In many cases the floral axis is prolonged beyond one or more circles of floral organs, and the stem again assumes the ordinary leaf-bearing form. Such a metamorphosis sometimes takes place in an apple or pear blossom; and as a result, there may be a fully developed fruit, with a leafy branch extending beyond the blossom end (basin).

The metamorphosis which has taken place in the strawberry-flower shown in the engraving is in the line of our expectation: the strawberry-plant propagates itself readily and rapidly by slender branches sent off from the base of the parent-plant. Each one of these runners strikes root at its apex, and soon develops a tuft of leaves and an independent plant. In the case discovered by Mr. Foster, this strong tendency to increase by runners is carried out by a flower-stem with a frost-injured blossom lying upon the moist earth.

BYRON D. HALSTED.

The reproduction of Clathrulina elegans.

In *Science*, iii. 55, is published a *résumé* of Miss S. G. Foulke's remarks before the Philadelphia academy of natural sciences in reference to the reproductive methods of Clathrulina elegans; her statements being apparently confined chiefly to a process by quadruple subdivision of the body into uniflagellate organisms as observed by herself, with allusion to three additional processes as observed by others. In August, 1881, the writer repeatedly witnessed two forms of reproduction with this rhizopod, in some respects quite different from what was observed or mentioned by Miss Foulke.

The body of Clathrulina in no instance withdrew its rays before subdivision, but underwent transverse binary fission; each part, even after complete separation, retaining its pseudopodal rays fully extended. Soon after dividing, however, one part became perfectly smooth, having possessed up to this point a conspicuous pulsating vacuole, which now curiously contracted, and did not re-appear. The remaining half of the original body underwent no change except that caused by the protrusion of rays from the freshly divided surface.

The recently separated portion then slowly passed out of the capsule, forming, just before its escape, two vibratile flagella of unequal length. Its movements began immediately, being only moderately active, and continuing for less than two minutes, when it suddenly lifted itself upon the flagella-bearing end, and instantaneously collapsed into a shapeless mass studded with short blunt pseudopodia, which almost as quickly became filiform; and the zooid was an Actinophrys-like creature, with two flagella trembling at its front. The latter were soon lost among the rays, and the animal at once began to form the pedicle by a slow extrusion of the body-sarcode. The whole process consumed about three hours.

From the same gathering I was also fortunate enough to learn how Clathrulina produces the colonies occasionally met with. The process, up to the escape of the biflagellate zooid, even with the strange conduct of the contractile vesicle, was as just described. The longer of the flagella, however, terminated in a conspicuous bulb-like enlargement, which remained within, but was not attached to, the parent-shell. The vibrations of the short lash gave the zooid a rapid rotatory and oscillating movement, the anchoring bulb slipping freely from side to side of the opening in the lattice. Motion continued for perhaps five minutes. The obovate body then became rounded, the smooth surface roughened by irregular protrusions extending into filiform rays, until another flagellate Actinophrys-like creature appeared, loosely anchored to a Clathrulina lattice. It remained motionless on the extremity of the apparently rigid bulb-bearing lash, which I supposed would become the pedicle; but in a few moments an unusually thick pseudopodium was extruded, and attached by an expanded base to the capsule. On this the Actinophrys, with all its rays extended, was slowly lifted to the required distance above the parent; while the anchoring flagellum became more and more attenuated, the bulb less and less noticeable, until both finally disappeared.

It seems, then, that Clathrulina elegans has six reproductive methods, — "by self-division, by the instantaneous throwing-off of a small mass of sarcode, by the formation and liberation of minute germs," by the quadruple subdivision of the body into uniflagellate organisms, by the separation from the body of a free-swimming Heteromita-like zooid for the dissemination of the species, and by a similar body-fission whose resulting biflagellate organism is anchored to the parent-capsule for the formation of a colony.

DR. ALFRED C. STOKES.

Trenton, N. J.

Formation of anchor-ice.

On the 17th of January, this year, I had occasion to cross the River St. Lawrence in one of the small Indian ferryboats which ply between the Indian village of Caughnawaga, on the south shore, and Lachine, on the Island of Montreal. The current of the river at this point flows at the rate of four or five miles an hour, I think, and never freezes over. The day was quite stormy, the thermometer indicated about 12° or 15° F.; and the river was pretty thickly covered with cakes and masses of porous or very snowy ice. But the most peculiar phenomenon was the sudden and almost incessant rising of dark, muddy ice from the bottom of the river. The formation of this ice so far below the surface of the water is supposed to take place in very cold weather, when large masses of snow, descending the river, become saturated with water, and are carried by the current to the bottom, where they stick to the rocks and stones, clinging more firmly and becoming more compact as long as cold weather continues. At least, this is the theory that the Indians advanced. The ice may be seen six or eight feet under water, and often accumulates until it forms miniature islands. When it rises, it often lifts considerable quantities of small stones and gravel to the surface.

Another peculiar circumstance is, that this rising of the ice from the bed of the river always occurs a day or two before the approach of mild weather; and the Indians regard this phenomenon as an infallible presage of milder weather within forty-eight hours. The cause is most likely atmospheric, but I record the observation with the hope that it may be a hint to some one willing to make a further study of the subject.

J. G. J.

Chateauguay Basin, P. Q., Canada.

Manayunkia speciosa.

In this worm, described and figured by Leidy (*Proc. acad. nat. sc. Philad.*, 1883), the tentacular crown, or branchial organ, is the feature of special interest.

According to Leidy, the tentacles present in an adult are eighteen in number, besides two larger and longer tentacles situated dorsally, midway between the two lophophores. These larger tentacles are conspicuous by their bright green color, and are, in fact, external continuations of the blood-vessels extending lengthwise throughout the body. In shape these tentacles taper from base to apex, are convex on the outside, but concave on that side facing the centre of the tentacular crown; so that a transverse section would present the shape of a crescent. The two longitudinal edges thus formed are fringed with cilia. When closely watched, the green tentacles are seen to pulsate with a rhythmical motion, contracting and expanding laterally. The pulsation takes place in each tentacle alternately. At the moment of contraction the tentacle turns slightly on its axis outwards, and towards the end of the lophophore on that side, at the same time giving a backward jerk, returning to its former position at the moment of expansion. By force of the contraction the green blood filling the tentacles is forced downwards, out of the tentacle, and flows along the blood-vessel on that

side of the body. On the expanding of the tentacle the blood instantly returns, and suffuses it; and thus the process goes on. The contraction and expansion occur at regular intervals, together occupying the space of two seconds. It is in this way that the blood is purified and the circulation controlled. The above observations were made with a seven-eighths inch objective, the subject being placed in a zoöphyte-trough.

To ascertain how long the cilia upon the tentacles would continue their motion after separation from the worm, both lophophores of an adult were cut off above their own junction. At first the tentacles remained closed: but soon they expanded, the cilia displaying active motion; and presently the two separated lopophores began to move about in the zoöphyte-trough. This motion was produced by the action of the tentacles, which bent in all directions, their tips touching the glass, and was not a result of ciliary currents. In a few minutes one lophophore had *crawled* in this manner quite across the trough, while the other remained floating in the water near its first position. Sometimes the motion was produced by ciliary currents, the tentacles remaining motionless; but this was quite distinct from the *crawling* above noted.

During this time the decapitated worm had sunk to the bottom, and, though twisting and turning a good deal, did not attempt to protrude the mutilated support of the lophophores. Its body was so much contracted that the segments were not above one-third their usual size.

At the end of five hours the worm was apparently dead; numbers of infusoria had collected to prey upon it; and the surface of its body presented a roughened appearance, as though covered with tubercles. The lophophores were still in motion. At the end of the eighth hour the lophophores had ceased to move, and were paler and more transparent; but the ciliary action, though feeble and uncertain, still continued. The body of the worm was then covered with a thick fungoid growth, consisting of transparent, rod-like filaments, three-sixteenths of an inch in length, some of the filaments having a beaded appearance. All motion of the cilia upon the tentacles had now ceased, and these latter were also the prey of infusoria.

The above experiment showed that the independent motion of the cilia continued about twice as long as the mutilated worm gave evidence of vitality. Several individuals of Manayunkia were observed to be preyed upon while still alive by large monads, embedded in one or more segments, which were sometimes excavated to a considerable degree.

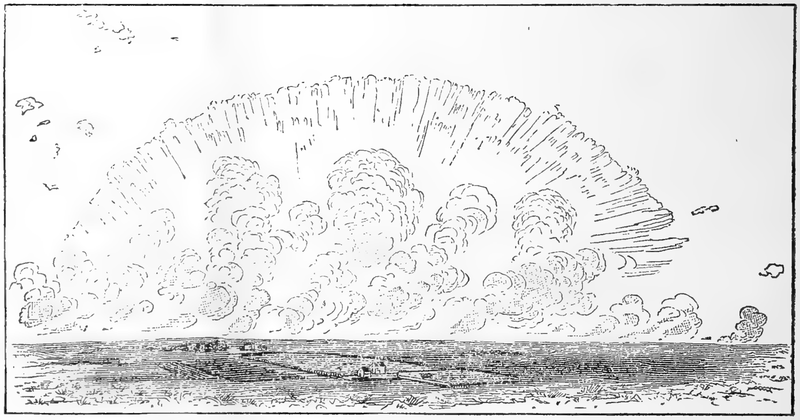
SARA GWENDOLEN FOULKE.

Appearance of the cyclone cloud at Rochester, Minn., 1883.

On Tuesday, Aug. 21, I left Minneapolis at three o'clock in the afternoon for Albert Lea, Io.

Late in the afternoon my attention was attracted to a remarkable storm-cloud that lay along the eastern horizon. As the sun grew low in the west, this cloud assumed most extraordinary proportions and colors; so much so, that it attracted almost universal attention. A strange, fan-like sheet of yellowish cloud, with broken but decided margin, rose above the centre of the storm like a great halo. It did not seem to stand in a vertical position, but projected above, toward the west, giving the effect of a huge funnel, viewed from below, on the exterior surface of which the descending sun cast shadows, and brought out a sort of radiate ribbed structure.

Beneath this was a great cluster of swelling cumulus 'thunder-heads,' whose bases were hidden by the horizon. Three of these, higher than the others, rose vertically from the centre of the mass; their magnificent fleece-like heads entering and apparently penetrating the yellow halo. These, especially the middle and largest one, glowed brilliantly in the strong sunlight, and cast long blue shadows down the inclined under-surface of the halo.



Encircling this brilliant mass were a number of enormous 'thunder-heads' of a most murky and forbidding appearance, that stood upright, like so many pillars of dense smoke. These upright clouds inclined a little to the east or south-east, indicating a movement in that direction.

There was a remarkable stability about the whole mass of clouds, and at sunset the effect was grand in the extreme. The sky about was clear, with the exception of isolated masses of cumulus-cloud.

I made a small pencil-sketch of the cloud-forms, with notes of color, and, since my return to Washington, have made a drawing in color.

I estimated that the cloud was from forty to fifty miles east of the railway, and, on studying the map carefully, became convinced that this was the cloud attending the great cyclone at Rochester. My attention was not called to the cloud until after five o'clock, at which time it was directly east of me, at Wilton. As the course of the cyclone was a little to the north of east, the movement was directly from me when the sketch was made.

The peculiar form of the halo, whether fan or funnel shaped, was doubtless, in a measure, the result of the movements of the storm-currents.

W. H. HOLMES.

Geological survey, Washington.

Stones placed in pine-trees by birds.

About seventy-five miles south of the United States boundary, near this place, at an elevation of six thousand feet, is a stretch of table-lands covered with large pines (Pinus Jeffreysi?), broken by many ridges of giant granite bowlders, decomposing sufficiently to add materially to the soil. Broad, grassy meadows furnish food for cattle and deer.

My father and myself, in riding through this forest in July, 1883, noticed several pines with the bark bored into at varying distances from the base of the tree to the branches; and in about one-third of the holes were the acorns of the here common Quercus Emoryi, very tightly fitted, the holes containing the acorns apparently newly made. The remaining holes were weather-beaten; and in them were equally tightly fitted bits of the granite gravel, of size corresponding with the acorns in the other holes. In the Cuyamaca Mountains, of this county, a gentleman observed Colaptes auratus visit pines that contained similarly disposed acorns. The woodpecker tapped the acorns, breaking one now and then; the broken shells showing plain traces of having contained a worm, while the other acorns contained sound kernels. But what object could the birds have in substituting stones as shown above? Possibly they served as hiding-places for many insects which would otherwise have secured places inaccessible to the birds. C. R. ORCUTT.

San Diego, Cal., Feb. 16.

How a spider sometimes lifts heavy objects to its nest.

Last summer, while at Lynchburg, Va., I observed a spider — probably an Epeira — spinning a thread down from the upper section of a large fountain on the lawn of the Arlington hotel. He was some eight feet from the surface. I watched him descend to the water, where he captured a beetle that had unfortunately fallen into the large basin. The beetle must have been an inch long. Our Epeira made a turn of his line around his captive, and ascended all the way to his nest; immediately descending, he threw another loop around his prey, and again ascended to his nest, continuing this process for full ten minutes: to my surprise, while the spider was at his web, apparently overhauling and tightening the several threads that he had spun to and from the beetle, it left the water, and, evidently by elastic contraction of the threads, ascended full an inch from the surface. The spider spun down another lasso, and threw it round his victim, then retired and was busy with his lines, when the beetle again moved upwards. These operations were repeated, until, at the end of forty-five minutes, he had snugly secured his prey in his nest, at a distance of at least eight feet from the water, by this curious and interesting method.

Cambridge, March 3. E. P. LARKIN.

The use of the method of limits in mathematical teaching.

I notice in a recent number of *Science* a proposal to discuss the different methods of teaching the elements of the infinitesimal calculus, and, in connection with this, an allusion to Professors Rice and Johnson's 'New method of rates.'

I trust it is not out of place to suggest that the method in question seems to me very like the method given in Maclaurin's 'Fluxions,' which the author attributes, at least partially, to Newton; and that the present very general use of the method of limits is probably a case of 'the survival of the fittest:' for I have found in my experience as a teacher that those who are either too young or too slow to acquire at once the deeper conceptions of mathematics are often capable of doing very good work when the demonstrations are adapted to their comprehension.

The method of limits seems to me that which must be used with a class, if it is desired to give a sure foundation to as many as possible; the method of rates or fluxions requires rather more preparation of mind; and the infinitesimal method is best adapted to those who have mathematical genius.

The average engineer or architect is a person whose natural bent is towards construction and the use of tools. Such a person will, in all probability, require the infinitesimal calculus as a tool rather than as a recreation or a profession, and should therefore be trained by a slow and certain process — like the method of limits — in order that his real abilities may not be disguised by any slowness of comprehension in a matter which he can by patience acquire.

The weakness of mathematics as a general study in our institutions lies in the rapidity with which the successive steps are passed over; so that the slower pupils are left behind, and become discouraged. Old country schools do more solid work in average cases.

TRUMAN HENRY SAFFORD.

Williams college, March 1.

THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES.[1]

THE annual report of operations for 1883 has just been received. It shows a steady advance towards the completion of the international standards. All the principal instruments and apparatus have now been procured, and are in position. The *comparateur géodésique*, for which a contract was made with the *Société Génevoise* in 1882, was to have been delivered by August of last year. Various events conspired to delay its complete delivery; but at the close of the report the entire apparatus was on its way, and was to be set up in the early part of January. All necessary masonry work was done in the spring of 1883.

Changes have been made in the method of heating the room of the Brunner comparator. Hitherto it has been done by regulating the temperature of water held between the double zinc walls in which the room is enclosed. It has been found, however, that, in addition to the difficulty and expense of maintaining a constant temperature of the water day and night, trouble was experienced from frequent leaks in the zinc walls, necessitating repairs, and stopping the observations: consequently the maintenance of temperature by the use of hot water has been discontinued; and for it has been substituted hot air, which so far has proved satisfactory, and which, it is hoped, will solve the problem of heating.

[1] Comité international des poids et mesures. Septième rapport aux gouvernements signataires de la convention du mètre sur l'exercice de 1883. Paris, 1884. 54 p. 4°. See also *Science*, No. 16.

Observations made in the upper vault, five metres under ground, show that the daily variation of temperature is insensible, and that the annual range is only a few degrees. As it is apparently water-tight, it will serve as a safe place of deposit for the standards. In the lower vault, ten metres under ground, the temperature is steady at 11° C. throughout the year. At present there is trouble from moisture. Steps are taking to overcome this difficulty; and, when they are complete, the chamber will be ready for the reception of the prototypes.

The examination of the universal comparator has been completed, and all values determined save the final errors of division of the two-metre scale. Certain auxiliary scales needed for this work were ordered, and have just been received.

Modifications are being made on the Brunner comparator to admit of comparisons of metres under water.

The report for 1882 showed that the balance for vacuum-weighings had been received; but certain defects of construction were found to exist, and it was returned to the makers to have them remedied. It was again received last autumn, and now appears to maintain a vacuum in a satisfactory manner. Its examination, and the determination of its instrumental constants, will be immediately begun.

The manufacture of the standard metres and kilograms by Johnson, Matthey, & Co., is progressing. Analyses of the alloy show it to fill all requisite conditions. Up to the present time the progress has necessarily been slow, as the important questions of alloy, refinement, and mechanical execution, had to be provided for. These matters have now been satisfactorily settled, and the delivery of the bars and ingots may be expected soon to begin.

In the report of the operations during 1882 was given an account of the copies of the *mètre des archives* and of the *kilogramme des archives*, which, on April 26, were confided to the care of the director of the bureau. Although rigorously compared, and the relation to the standards of the archives accurately determined, these were not adopted as international prototypes, but were deposited as witness-copies of these standards. The kilogram, K_{iii}, elaborately compared with the *kilogramme des archives* in 1882 and 1883, was found to be identical in value thereto; and on Oct. 3, 1883, it was formally adopted as the international prototype of the kilogram.

During the year, changes have taken place in the *personnel* of the international committee and the bureau. The Turkish member of the original committee having taken no part in its deliberations since its organization, and repeated attempts to ascertain his future intentions in the matter having failed, his place has formally been declared vacant. The vacancy as yet has not been filled. The resignation of Mr. Marek as a member of the international bureau took effect from March 1, 1883. Dr. Max Thiesen of Berlin was chosen as his successor, and is charged with matters relating to weighing.

The second volume of the *Travaux et mémoires* has appeared, and contains a number of important papers relating to comparisons and to determination of coefficients of expansion. The third volume is in press, and in great degree printed. It is expected to appear in a few months. The material for the fourth volume is in large degree prepared.

Although the comparison of the international standards has not yet begun, a number of national standards have been compared, and important physical investigations made.

Comparisons of much interest to Americans are those between the British platinum kilogram and a platinum-iridium and two brass avoirdupois pounds and the prototype kilogram, as through them our own weights are brought into more direct relation with the international standards. Also a steel metre belonging to the U. S. lake survey has been compared for length and coefficient of expansion.

Experiments with the Fizeau expansion apparatus have given a new and elaborate redetermination of the change, with temperature, of the index of refraction of atmospheric air; and the coefficients of expansion of many minerals have been determined. An elaborate redetermination of the wave-length of the sodium-ray is in progress.

Correspondence is in progress with Mexico with a view to the adoption, by that government, of the articles of the metric convention.

H. W. BLAIR.

A QUESTION OF EXPOSURE.

THE extraordinary depressions in temperature, which occurred in the month of January in many parts of the country, have attracted an unusual amount of attention to questions of thermometry. In some instances it has been observed that the areas of excessive cold were smaller than might have been anticipated, great differences often existing where there were no

geographical or topographical reasons for them. A comparison of reliable observations, made during this period, furnishes evidence of the great importance of considering the situation and exposure of thermometers.

In the state of Ohio, there were three distinct periods of great depression during the month; and at two of these the minimum temperatures were unprecedented in the history of the state. The important fact, however, to which it seems desirable to call attention, is that the records of the U. S. signal-service observers contain no account of these extraordinary cold-waves; and we should be ignorant of their existence, if obliged to depend for information upon these records alone. This fact can be attributed, in some degree, to the small number of regular signal-service stations in the state, but in a far greater degree, in the opinion of the writer, to the situation and exposure of the thermometers of that service.

The Ohio meteorological bureau has more than twenty observing-stations, pretty well distributed over the state. The observers are generally persons of more than ordinary intelligence, and many of them have had long experience in meteorological observations. The instruments which they use are of the best pattern, being similar, in fact, to those in use by the U. S. service; and all have been compared with the standards at Washington, through the kindness of the chief signal-officer, and their errors are in most cases very small.

The U. S. signal-service has four regular stations in Ohio, situated at Toledo, Cleveland, Columbus, and Cincinnati. A station at Sandusky has recently been re-established; but reports have not been received from that station, for the month of January, by the Ohio bureau.

The first cold-wave was most severe on the 5th, 6th, and 7th. On the 5th the mean minimum for the state, from the observations of the State service, was −16°; and from those of the U. S. service it was −12°. The lowest temperature recorded by the State service was −24.4°; and by the U.S. service it was −16.3°. On the 6th the mean minimum and the lowest temperature, as recorded by the State service, were −15.3° and −24.6° respectively, the corresponding numbers from the records of the U. S. service being −12.2° and −20.3°. On the 7th the difference was still more marked; the numbers being −11.6° and −19.6° for the State service, and −2° and −7° for the U. S. service.

The second great depression was of short duration, and was most severe on the 21st. On that day the mean minimum for the state, from the State-service observations, was −11.1°, while from those of the U. S. service it was +1.4°. The lowest temperature recorded by the State service was −31°, and by the U. S. service was −3.7°. These minima were recorded at the same place, Columbus; the distance between the stations being slightly less than three miles. It seems difficult to understand how two stations so near to each other could furnish results differing from each other so greatly.

The question appears to be purely one of situation and exposure. The U. S. signal-service thermometers are exposed in a box or case of the usual form, attached to the north side of a stone building in the centre of the city: those of the State service are exposed in a somewhat similar shelter, but in an open space on the campus of the Ohio state university, at a considerable distance from any building. The conditions on the night of the 20th and 21st were peculiarly favorable to the production of such a result as that given above. During the 20th the temperature was not very low; and in the evening and night the sky was clear, and there was scarcely any movement in the atmosphere. The rapid fall in temperature was unaccompanied by movement of masses of air; and, as a result, the air confined in the shelter of the U. S. service thermometers was not displaced; and, being in contact with a large building which lost its heat slowly, the fall in temperature was not great. Had there been a brisk wind, or even a breeze, the result would have been different. The minimum of −31°, recorded by the State service, cannot be questioned; as it was supported by numerous readings from 'private' instruments, equally reliable, in the immediate vicinity and in the neighborhood of the city. At Westerville, twelve miles distant, a minimum of −24° was recorded by one of the observers of the State service.

Nearly as great a difference was exhibited in the records of the 25th. For this 'dip,' which was the lowest of the three, the mean minimum for the whole state, as obtained from twenty-two stations of the State service, was −19.8°, while from the records of the U. S. service it was only −5.1°. The lowest temperature observed by the State service was −34°, while the lowest reported by the U. S. service was −15.1°.

These comparisons lead to some conclusions which are certainly not without importance in the study of climatology. In these instances it appears that the U. S. signal-service has failed to obtain the mean lowest temperature

by from 3° to 15°, and that it has missed the minimum on different days by 5°, 8°, 13°, 19°, and 27°.

Improper exposure of thermometers will account for a part of this discrepancy; and it is well known that the chief signal-officer has already recognized the importance of this point, circulars having been distributed, some months ago, to all volunteer observers, requesting detailed information concerning the manner and method of exposure. The location of the station appears to the writer to be of even greater importance. It is unfortunate that nearly all stations of the U.S. signal-service are in large cities, and often in the most densely built and populated portion of them. Concerning temperature, at least, it is not likely that such situations will give results of great value, even with the most careful attention to exposure.

From geographical and topographical considerations, the station at Columbus is more likely to fairly represent the state of Ohio than either of the others; but the above observations show that it may fall far short of doing it. Observations taken at Cincinnati represent little more than the conditions in that city, the topography of that region being such that the city might almost be said to have a climate of its own. One of the State-service stations is at Waverly, the latitude of which is very nearly the same as that of Cincinnati. On the 21st, Waverly reported a minimum of −14°, and Cincinnati, of +7.9°; and on the 25th, Waverly reported −27.2°, and Cincinnati, +3.7°. In Cleveland and Toledo the climate is modified greatly by the presence of Lake Erie. At Wauseon, thirty miles from Toledo, the minimum is reported on the 25th as −31.7°; and at Toledo it was −9°.

There are, doubtless, excellent reasons why these stations should be where they are, and also why it is generally desirable to locate stations in large cities; but there seems to be little doubt that for temperature measurements it would be well to put stations *near* rather than *in* large cities, and at sufficient distance from them to be free from purely local conditions.

The importance of the maintenance of state weather-services is not so generally appreciated as it deserves to be. It is impossible for the U.S. service, at least at present, to increase the number of its stations to the extent that would seem desirable and necessary in order to obtain the details of climatic conditions. The organization of state services is generously encouraged by the chief signal-officer; and if they become general, and are efficient, they may be of great service to the very competent corps of government meteorologists in their investigation of general problems in climatology.

T. C. MENDENHALL.

IRON FROM NORTH CAROLINA MOUNDS.

IN the Proceedings of the American antiquarian society, vol. ii. p. 349 (1883), Professor Putnam reviews the statements of the old writers respecting metal found in the western mounds. He comes to the conclusion that Mr. Atwater's iron-bladed sword or steel-bladed dagger is to be traced to that gentleman's lively imagination.

Although Professor Putnam may be correct in his conclusion, a discovery made in North Carolina by one of the assistants in the Bureau of ethnology, during the past season, would seem to render the statement made by Atwater in regard to finding the fragment of an iron sword-blade in an Ohio mound at least probable.

In order that the reader may understand the conditions under which the articles to be mentioned were found, it is necessary to give a description of the burial-place, which I do by copying the report of the assistant.

"This is not a mound, but a burial-pit, in the form of a triangle, the two longest sides each forty-eight feet, and the base, thirty-two feet, in which the bodies and articles were deposited, and then covered over, but not raised above the natural surface. The depth of the original excavation, the lines of which could be distinctly traced, varied from two and a half to three feet. A rude sketch of this triangle, showing the relative positions of the skeletons, is given in fig. 1.

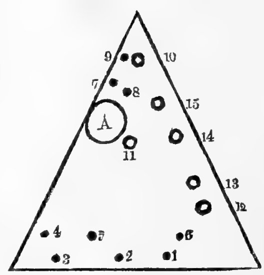


FIG. 1.

"Skeletons Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9 were lying horizontally on their backs, heads east and north-east. By No. 2 was a broken soapstone pipe; by No. 5 and also by No. 9, a small stone hatchet.

"Nos. 10, 11, 12, 13, 14, and 15 were buried in rude stone vaults built of cobblestones similar to those in fig. 2, which represents the arrangement of the bodies and vaults in a mound near by. (This mound was over a circular pit.) Nos. 10, 12, 13, and 15 were in a sitting-posture, and without any accom-

panying articles. Graves Nos. 11 and 14 contained each two bodies extended horizontally,—the lower ones, which were of smaller stature than the upper ones, face up, and with heavy flat stones on the extended arms and legs; the upper ones with the face down; no implements or ornaments with them.

inscribed shells were found. Scattered over and among these ten or more skeletons were found hatchets (polished axes and celts), rubbing and discoidal stones, copper arrow-points, mica, paint, black lead, etc."

This is sufficient to indicate the conditions under which the iron specimens were found.

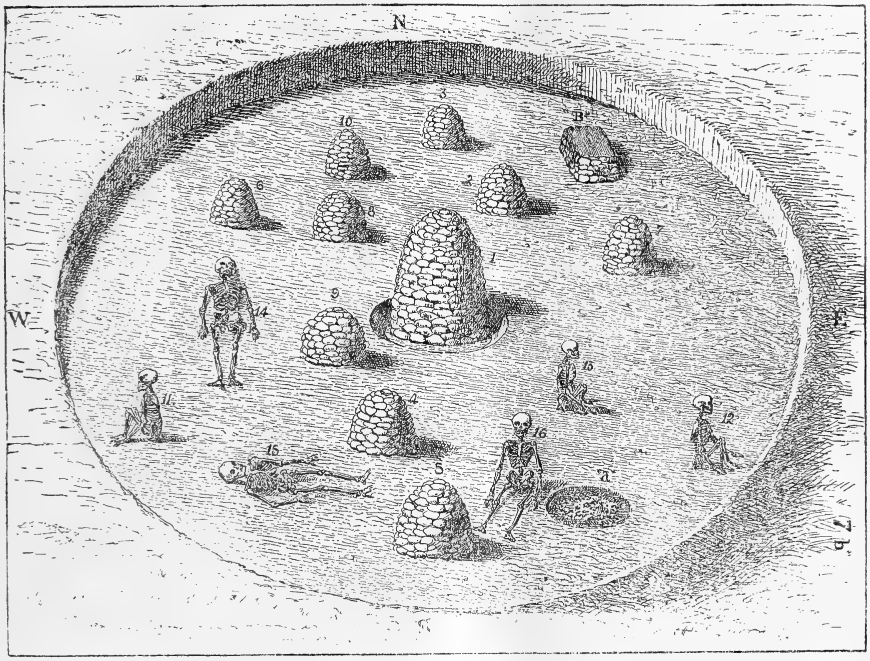


FIG. 2.

"On the north-west side of the triangle, at *A*, fig. 1, ten or more bodies were found which appeared to have been buried at one time; the old chief (?) with his head north-east, face down. Under his head was the larger sea-shell with hieroglyphics. Around his neck were the largest-sized beads. At or near each ear were the larger pieces of copper: there was also a piece of copper under his breast. His arms were extended, and his hands rested about one foot from each side of his head. Around each wrist was a bracelet composed of long, cylindrical, copper beads and shell beads alternated. *At his right hand were found the implements of iron.* Under his left hand was a sea-shell with hieroglyphics inscribed on the concave surface, and filled with beads of all sizes.

"Around and over him, with their heads resting near his, were placed nine or more bodies. Under the heads of two of these skeletons, resting within a foot of the chief's (?), similarly

It is proper to state that every article named was immediately forwarded to the bureau, and is now in the National museum. The celts and axes, which are chiefly of greenish sienite, are highly polished, and equal in finish to the finest hitherto discovered in this country. The pipes are well made, and mostly well polished. The engraved shells are fine, large specimens, the engraved design on each being of the same type as that shown in fig. 3, plate xxx., of Jones's Antiquities of the southern Indians.

The iron specimens alluded to are now before me, and are four in number, much corroded, but still showing the form. Two of them are flat pieces, of uniform thickness, not sharpened at the ends or edges, three to three and a half inches long, one to one and a half inches broad, and about a quarter of an inch thick. Another is five inches long, slightly tapering in width from one and an eighth to seven-eighths of an inch, both edges sharp, and is, without doubt, part of the blade of a long, slender, cutting or

thrusting weapon of some kind; as a sword, dagger, or large knife. The other specimen is part of some round, awl-shaped implement; and a small fragment of the bone handle in which it was fixed yet remains attached to it.

The bureau is also in possession of another rudely hammered, small iron chisel or celt, found under somewhat similar conditions in a mound in the same section.

It is evident, from what has been stated, that we cannot ascribe the presence of this metal to an intrusive burial. The people who dug the pit, deposited here their deceased chief, or man of authority, and placed around him, and those buried with him, the pipes, celts, axes, engraved shell-gorgets, and other implements and ornaments, undoubtedly placed here, also, the pieces of iron.

Whether the burials were comparatively modern or pre-Columbian, the evidence furnished by these fortunate finds compels us to conclude that the people who made these polished celts and axes, who carved these pipes, who made or at least used these copper implements, and engraved these shells with the figure of the mystic serpent, so strongly reminding us of Central-American figures, also had in possession these iron implements, and were mound-builders. That this burial-pit was made by the same people who erected the mounds of this region cannot be doubted.

CYRUS THOMAS.

PENNSYLVANIA ANTHRACITE.

SOME of the commonest articles used, either for manufacturing purposes or in the household, are frequently those about which we have the least definite information as to their composition or value. Near the point of production or manufacture, the consumer is apt to exhibit the most discriminating judgment in the selection of special brands or grades, on account of closer competition and a greater variety from which to make a selection. This is frequently done on the basis of a personal estimate, without substantial facts to warrant it. To no natural product does this apply with greater force, at the present time, than to the Pennsylvania anthracites, which are now depended upon by manufacturers and housekeepers, either as a necessary or luxuriant fuel, throughout portions of the entire western continent, and are used at points as distant as China and Japan.

Both the manufacturing and domestic consumers are beginning to realize the fact that their coal purchased this year does not seem to burn so freely, does not fire with so little trouble, and does not last so long, as that purchased during the last and previous years, or *vice versa*. Where coals of different sizes, or from different districts, are offered to the trade by the same or competing salesmen, the question suggests itself, what shall we buy?

Among housekeepers, who are the smallest and most numerous class of consumers, distinction is seldom recognized between these anthracites. By other consumers the coals are grouped into those, which, when burned, will produce either a white or a red ash, special qualities being arbitrarily attached to each. Others, again, know only of three varieties: 1°, those from the Wyoming and Lackawanna fields, or the coals shipped from the northernmost basins over the railroads running through north-eastern Pennsylvania direct to New York (notably, the Delaware, Lackawanna, and Western, Delaware and Hudson, and Erie railways); 2°, those shipped by the Lehigh valley railroad, and the Central railroad of New Jersey, down the Lehigh valley; and, 3°, those over the Philadelphia and Reading railroad down the Schuylkill valley. Still other distinctions are arbitrarily made, which it is not necessary to note. In special localities, where a favorite coal is largely used, the consumer will speak of one class, that composed of his favorite coal, which possibly comes from two or three collieries, with a total aggregate annual production of less than a million tons; and of a second class, that composed of the coals from all other collieries, represented by an annual production of over thirty million tons. I have noticed this particularly in sections of New England, where even an intelligent consumer will sometimes speak of Lykens valley coal and of all other Pennsylvania anthracites.

The pressing demand which has been made upon the Geological survey of Pennsylvania, for some answer as to the fuel-value of different coals, has led me to consider what is the composition of Pennsylvania anthracite, as a preliminary step in the investigation.

Various percentages of fixed carbon have been assigned by different authorities to a typical anthracite. That which has been most generally accepted has been about 94, with all the accidental impurities, such as those which are generally classified under ash and sulphur, eliminated. Professor Rogers (Final report of first survey, vol. ii. pp. 969, 970) gives analyses of fifteen specimens of hard, dry Pennsylvania anthracite, which show an average, of fixed carbon, 88.05; of volatile matter, 5.81; of

ash, 6.14. Eliminating the ash from these analyses, the percentages of the constituents of fuel are as follows: fixed carbon, 93.8; and volatile matter, 6.2. This result is identical with the composition assigned by Newberry to a typical anthracite (Johnson's cyclopaedia, vol. i. p. 993).

The range of fixed carbon in the analyses of these fifteen specimens was from 94 to 80; the specimen showing the maximum being obtained from near Pottsville, and that showing the minimum from near Pine Grove, both from the Southern field in Schuylkill county. The range in volatile matter in the fifteen analyses is from 1.40 to 9.53; the minimum amount being in the same Pottsville specimen, and the maximum in a specimen from Black Spring Gap. The range in ash was from 2.90 in a specimen from Tamaqua, to 12.28 in a Pine Grove specimen. These results are certainly misleading; for it has been a long-recognized fact, that the coals obtained in the Southern field do not contain the highest percentages of fixed carbon.

Taylor (Statistics of coal, 2d ed. p. 609) gives analyses of a number of Pennsylvania anthracites reported from various sources. Twelve specimens from the Panther-Creek basin, between Mauch Chunk and Tamaqua, showed the following: —

	Averages.	Maximum.	Minimum.
Carbon	89.21	92.60	86.00
Volatile matter	6.38	8.00	4.54
Ash	4.41	7.00	1.28

Six specimens from the Lehigh region gave —

	Averages.	Maximum.	Minimum.
Fixed carbon	89.00	92.30	85.34
Volatile matter	7.05	9.60	5.36
Ash	3.93	8.73	1.28

All of these analyses, particularly those given by Taylor, are constantly quoted in numerous descriptions of Pennsylvania anthracite found in technical publications, both at home and abroad. The foreign books and journals have been reporting the higher results; so that the opinion prevails, that the hard, dry anthracite mined in the state will range from 90 % to 94 % of fixed carbon in the market product. Such is, however, not the case, as recent analyses[1] made by the Geological survey show.

[1] Andrew S. McCreath, analyst.

The results which have been reported in the Rogers and Taylor tables referred to may be taken as those of analyses of mineralogical specimens, which were in most cases carefully selected, either from the mined coal or from special portions of the bed. In no case, as I believe, are the analyses a guaranty of the character of the coal which was being mined or shipped as fuel from the individual localities at the time that the samples were collected. Even the specimens which were collected in considerable quantity, and analyzed and tested for their evaporative capacity by Johnson for the government in 1842 were not, I consider, fair averages of the coal which could be commanded in the market from the different mines for which his results were reported.

As indications of the composition of mineralogical specimens, the chemical analyses reported by Rogers and Johnson are of little scientific value, without a minute description of the physical characteristics and geological associations of the coal for which they stand. This conclusion could be substantiated by a number of instances to which I might refer; notably, one where I requested an experienced mining-expert to collect duplicate specimens from a point in one of the Mammoth bed mines, which, when analyzed, showed, much to my surprise, the following results: —

	Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.
1	2.590	3.883	86.233	0.851	6.443
2	2.440	3.998	80.301	0.649	12.612

These two analyses are worthless as indications of the fuel-value of the coal, because it would be unreasonable to suppose that either one or the other specimen, showing such a wide range of composition, could be taken as a fair average of the coal shipped from this mine. Nor are they of scientific value, without certain facts, connected with the occurrence of the coal at this special point, to suggest some reason why such wide differences should exist.

If the amount of combustible matter in a coal is any criterion of its fuel-value, an examination which has recently been made by the survey shows how ignorant we are as to the actual worth of the different coals which we burn, and how readily we may be deceived by the special characteristics of a coal which we may have noticed, and by which we may have judged of its heating-capacity.

In order to test the value to be attached to

the judgment of the trade in discriminating between different coals, I requested one of the largest miners and shippers of anthracite coal, who has for a great many years been connected with the mines over a wide area in the region, to name a number of coals, which, by most consumers, were credited with being of about equal value. Specimens of these coals were collected from one or two hundred tons, as they were ready to be shipped to market; the amount collected for each analysis, ranging in weight from one to two hundred pounds, which was then reduced by the ordinary methods now commonly used in sampling any mineral product for qualitative and quantitative tests. The number of specimens obtained in this way aggregated thirty-three. The analysis of each individual specimen is recorded in detail on p. xliv. of my 'First report of the progress of the anthracite survey,' issued by the state printer on the first of this month. For our present purpose it is not important to refer to the results in detail.

The table of averages which I have compiled shows the mean character of the coal obtained from the more important coal-beds in the Northern field in the vicinity of Wilkes Barre, in the Eastern middle (Lehigh) field in the vicinity of Hazleton, in the Western middle field in the vicinity of Shenandoah, and in the Southern field on the property of the Lehigh coal and navigation company, between Mauch Chunk and Tamaqua. These results are shown in the following table: —

No. of specimens.	Name of coal-bed.	Name of coal-field.	Chemical analysis.						Specific gravity.	Percentage of constituents of fuel.		
			Water.	Volatile matter.	Fixed carbon.	Sulphur.	Ash.	Total.		Fixed carbon.	Volatile combustible matter.	Fuel ratio, $\frac{C.}{V.H. - C.}$
3	Wharton . . .	Eastern middle .	3.713	3.080	86.404	.585	6.218	100	1.620	96.56	3.44	28.07
5	Mammoth . . .	Eastern middle .	4.119	3.084	86.379	.496	5.922	100	1.617	96.55	3.45	27.99
2	Primrose . . .	Western middle .	3.541	3.716	81.590	.499	10.654	100	1.654	95.64	4.36	21.93
5	Mammoth . . .	Western middle .	3.163	3.717	81.143	.899	11.078	100	1.657	95.62	4.38	21.83
2	Primrose? (F) .	Southern	3.008	4.125	87.982	.506	4.379	100	1.584	95.52	4.48	21.32
2	Buck-Mountain .	Western middle .	3.042	3.949	82.662	.462	9.885	100	1.667	95.44	4.56	20.93
1	Seven-foot . . .	Western middle .	3.410	3.978	80.868	.512	11.232	100	1.651	95.31	4.69	20.32
7	Mammoth . . .	Southern	3.087	4.275	83.813	.641	8.184	100	1.631	95.15	4.85	19.62
3	Mammoth . . .	Northern	3.421	4.381	83.268	.727	8.203	100	1.575	95.00	5.00	19.00

These analyses are arranged in the order of the percentage of fixed carbon in the fuel constituents.

A comparison of these results with those already referred to, as given by Taylor for the Panther-Creek basin, shows wide differences. The two Primrose and seven Mammoth specimens reported in the table for the Southern field came from the Panther-Creek basin; the average of the two Primrose coals indicating 1.29%, and the average of the seven Mammoth specimens 5.4%, less fixed carbon than Taylor's average; the minimum fixed carbon in the survey's analyses being 78 as against 86 in Taylor's table, and the survey's maximum being 88 against 92.6.

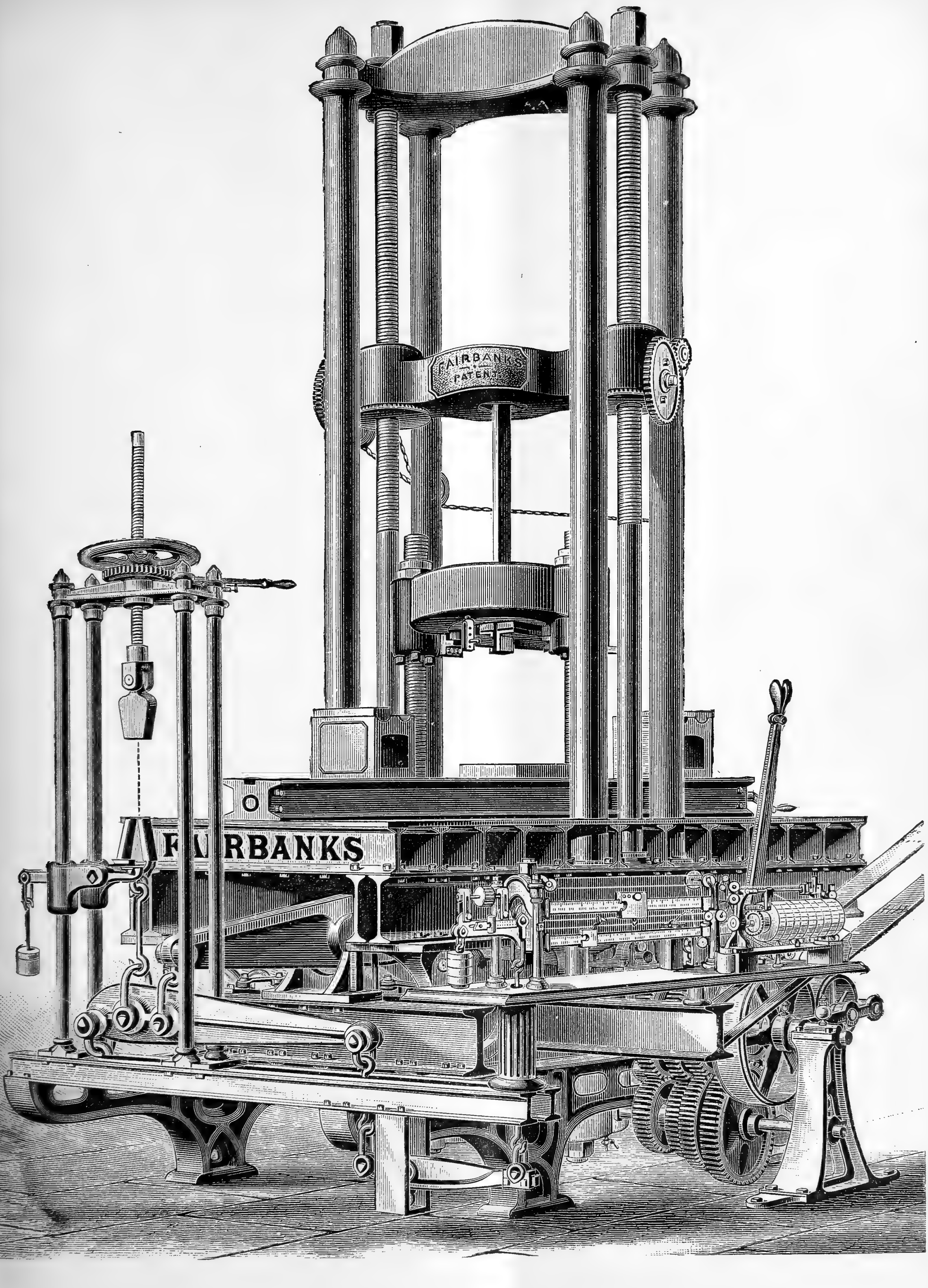
These results evidently prove, 1°, that the specimens which were collected in the past for analysis were not sampled with sufficient care; for with the improvements which have been made in breaker machinery, and the greater care exercised in the preparation of coal for market, we might reasonably expect to find the higher percentages in the more recent analyses: and, 2°, the necessity of changing the basis upon which Pennsylvania anthracite has been rated in the past.

CHARLES A. ASHBURNER.

IMPROVEMENTS IN TESTING-MACHINES.

SOME philosopher has remarked that the prosperity of a nation is directly in proportion to the success of its people as constructors. According to this maxim, America occupies a very high place in the list of nations. With our almost inexhaustible ore-beds, and fertility in inventing new processes of mining and working metal, the necessity of becoming better acquainted with the properties of American building-materials is daily growing more apparent; and at present no question is exciting more attention among our constructors than that of the strength of materials.

About two years ago Messrs. Fairbanks & Co. conceived the idea of locating in New York a bureau so arranged that engineers and all interested could be afforded an opportunity


FAIRBANKS
PATENT

to make experiments and tests on any material, and to give to America a laboratory that should speedily become to our country what the laboratory of Kirkaldy is to England.

Fig. 1 shows the machine now employed in their department of tests and experiments. The machine stands on two cast-iron legs, supported by any suitable foundation. On these legs there rests a framework of wrought-iron I-beams, so constructed as to give the entire structure an exceedingly solid and firm basis. This framework supports a system of levers arranged in a manner similar to that of an ordinary scale, only proportioned so as to withstand the severe stresses and shocks. These levers support a secondary framework, also constructed of I-beams, and carrying four columns. On the tops of these columns stands a heavy casting, from which are suspended two side-screws, carrying the top crosshead, to which one end of the specimen to be examined may be attached. These screws are simply used as a rapid and convenient means of adjustability, so that longer or shorter specimens can be tested. This system — namely, the adjusting-screws and top crosshead — is supported upon the framework of I-beams forming the platform. Beneath the top crosshead is a second crosshead, also supported on two screws, which are placed inside the adjusting-screws. These screws extend downward through the platform, and are attached to two worm-gears firmly secured to the under side of the bottom framework. The worm-gears may be rotated in either direction, at the pleasure of the operator, by means of the belt and gears at the right hand. The worm-gears and screws form the straining-mechanism, capable of applying any stress up to two hundred thousand pounds. Great care is taken in the construction, so that no part of this mechanism whatsoever shall touch, or in any other way come in contact with, the platform, save solely and simply through the specimen to be tested: consequently all the stress produced by the crosshead on the platform must necessarily pass through the specimen; and only this amount, and no more, can be estimated on the weighing-beam.

A part of the scale system may be seen in the front of the cut; the end of one of the large levers extending under the platform, and two smaller ones carrying the stress from the end of this lever to the beam. Over the larger one of these levers are four small columns supporting a handle and lever. This apparatus is a testing-machine in miniature. The full power of the machine may be used, having a capacity of two hundred thousand pounds, reading to ten pounds, and accommodating specimens up to ten feet in length; or by means of the lever a force of ten thousand pounds may be exerted, reading to half-pounds, and accommodating specimens up to five feet in length.

The platform of the machine occupies considerable space, being some ten feet long by six feet in width. As this platform is supported on the scale, any weight which is placed on it must be felt by the beam; and, in order to test the machine, all that is necessary is to pile on the platform a series of standard test-weights.

Fig. 2 is a transverse section. Here the legs are shown supporting the beams in the same way as in the previous drawing. The lower crosshead screws, *k k*, carry the crosshead *C*, while the screws *h*, carrying the upper head, are in front of the columns *j j*. At the left may be seen the driving-apparatus for furnishing the power to the lower crosshead, the belt l^3 being arranged to slide to and fro on a tight and loose pulley. The tight pulley conveys the motion of the belt to the top driving-shaft. On this shaft there is a set of three gears, arranged in a manner very similar to the back gears of an ordinary lathe, by means of which three different speeds may be communicated to the main driving-shaft, *l*. Just to the right of these three gears may be seen a set of reversing-gears, so arranged, that, by throwing a lever to and fro, the crosshead may be run either up or down, at the will of the operator. On the driving-shaft, *l*, are placed two worms, cut, respectively, right-handed and left-handed. These match in the corresponding worm-gears which are placed at the bottom of the screws *k* and *k*. The main screws are cut right and left handed, so as to turn in opposite directions, neutralizing all the frictional stresses of the crosshead, and preventing any tendency to twist.

Perhaps the action of the machine can be well understood by supposing a test-piece in tension. The piece is secured in the top crosshead, *B*, by wedges; the other end, secured to the lower crosshead, *C*, thereby forming the only connection between the platform and the driving-mechanism. As fast as the screws are turned, stress is exerted on the specimen, which is communicated to the platform, and weighed by means of the beam at the left hand.

The results of tests are so largely dependent upon the skill of the operator, that very naturally much hesitation has been felt in accepting them as conclusive. It has been the aim,

in the design of the present machine, that as far as possible the machine should do its own work, thereby eliminating from the result all personal equation; and, supposing the machine of the machine coincide with the axis of the specimen. In making experiments on wrought iron and steel, and upon other materials which are more or less of a ductile character, this

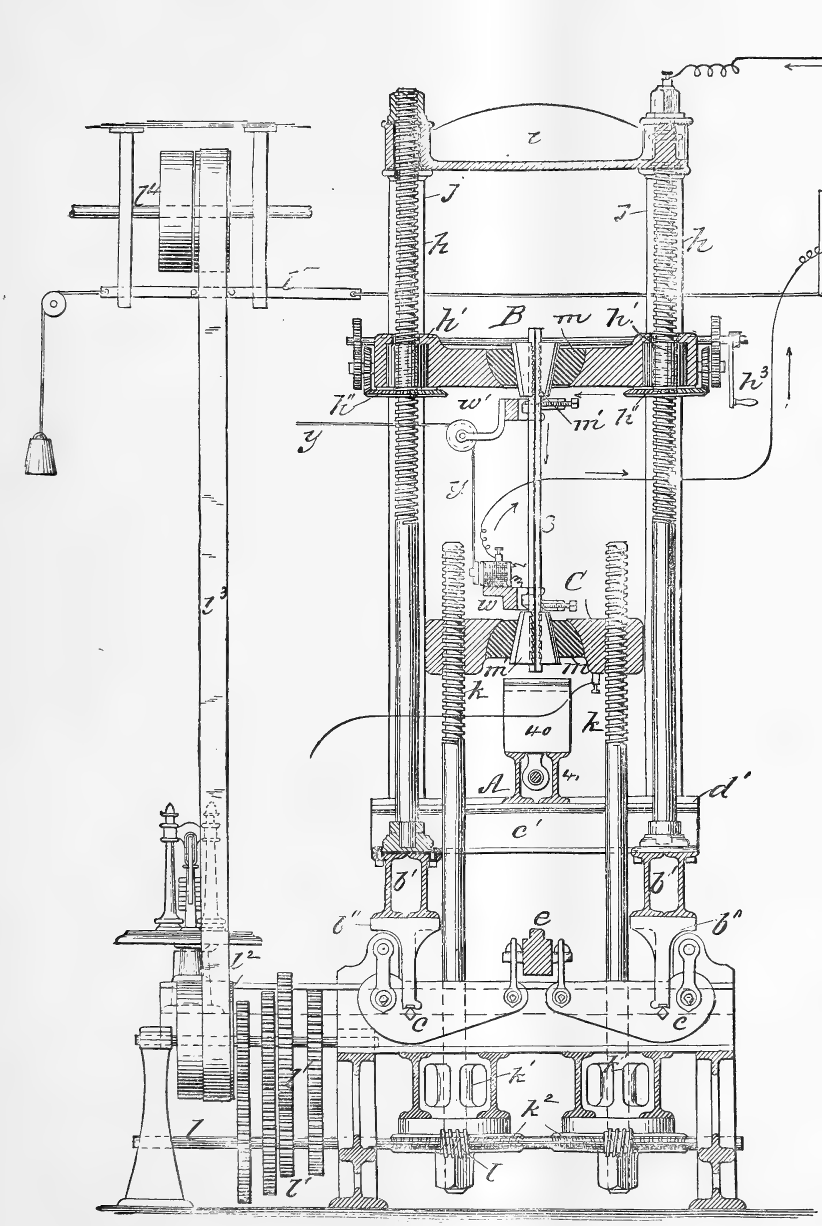


FIG. 2.

to be once correct, all subsequent records should be correct mechanically. One of the greatest obstacles to making accurate tests has been the feasibility of making the axis of stress objection is not a serious one, as it introduces but a slight error in the results. In experiments on cast-iron, cast-steel, or materials of a brittle character, the slightest cross-strain

vitiates the results, introducing stresses into the test-piece which produce an effect not to be calculated upon.

By referring to fig. 2, a device for enabling the machine to automatically centre the test-piece may be understood. The top and the bottom crossheads have in their centres a large spherical concavity. This concavity contains a segment of a sphere in which the wedges for griping the test-piece are placed. The spherical segment is made of steel turned and polished, and the concavity is lined with the best anti-friction metal. Any eccentric stress swings the segments in their sockets, and causes the axis of stress in the machine to coincide with the axis of the test-piece. The spherical segments weigh about two hundred pounds. They are, however, carefully supported on India-rubber springs, so as to eliminate as far as possible the weight of the segment from the friction in its socket. But supposing, under the most unfavorable circumstances, the whole weight of the segment does come on the joint, the coefficient of friction is not over two per cent: consequently a maximum cross-strain of four pounds on the test-piece will cause the segment to swing, and to adjust itself to the axis of stress through the piece. As this weight of four pounds is less than half the least reading of the poise, it may be assumed to produce no sensible effect on the piece to be examined.

The most of the testing-machines now in use require a careful preparation of the test-piece previous to an examination. If, for example, it is wished to ascertain the strength of an I-beam or of a channel, it is necessary to send the shape to the machine-shop, and plane a piece of one or two inches in area. This requires much time and expense. The specimen is then sent to the testing-machine and broken; and what is obtained? Simply the result of a piece cut from the shape, which may or may not give a fair knowledge of the actual strength of the member in question. What is wanted at the present time is not the strength of a carefully prepared test-piece, broken under special circumstances, but of the actual bar just as it comes from the rolls in the mill itself. The spherical segments in the crossheads of the Fairbanks testing-machine have four sides inclined at an angle of about twelve degrees to the axis of the machine. Two of these sides are curved, and two are straight. By using a number of wedges with backs correspondingly curved or straight, any piece, of whatsoever section, may be completely surrounded by the wedges, and griped on all sides; so that a channel, an angle, and I-beam, a T or a star, or, indeed, any of the shapes now rolled in the mills, may be placed in the machine and broken in full size.

Much time and labor have been spent to accomplish the power of autographically recording, at each instant of time during the experiment, the amount of stress, and the effect produced thereby on the specimen. To the best of the author's knowledge, Professor Thurston of the Stevens institute was the first to originate the idea of making a testing-machine in such a manner as to record graphically. In 1876, at the Centennial exhibition, Professor Thurston exhibited a machine designed to make tests in torsion and to record the action thereof. As a matter of history, it may be stated, that, while engaged in examining material for the East River bridge in 1877, the author designed and built the first testing-machine to autographically record results of the experiments in other stresses than that of torsion. While this machine, being the first of its kind, was necessarily crude and imperfect, it gave for some years very satisfactory results, and is still in use by the Bridge company. While the present machine is essentially different from the one just mentioned, the principles employed are the same as those devised for the East River bridge.

Referring to fig. 2, it will be seen that the battery *G* is attached to the top of the adjusting-screws *hh*. These screws are carefully insulated from the rest of the machine. As soon as the test-piece is placed in the top crosshead, it becomes thereby connected with the battery. On the lower end of the specimen may be seen a small clamp, carrying an electro-magnet. One end of the wire of this magnet is in connection with the specimen, while the other end of the wire is joined to a little binding-screw on top, to which the other pole of the battery is attached; so that the current actuating this magnet flows through the test-piece under examination. It will also be seen that the magnetic clutch, *m*, for holding the driving-belt on the tight pulley, is also included in this part of the battery-circuit. When the rupture of the test-piece occurs, the current is broken, the magnetic clutch is released, the belt slides by means of the counterpoise weight to the loose pulley, and the testing-machine stops. On the top of the specimen nearest to the upper crosshead is attached a second clamp, carrying a small sheave or pulley. Around this pulley, parallel to the specimen, and attached to the armature of the lower clamp magnet, passes a flexible steel tape, *y*, that, after passing alongside the specimen, runs

down to a pencil or stylographic pen that is carried on a sliding-track placed over a metal cylinder carrying a sheet of cross-section paper. It is obvious, that, as fast as the specimen elongates under the action of the stress, the pencil is drawn along the ways of the cylinder parallel to its axis.

Figs. 3 and 4 show the beam and registering-cylinder. In fig. 3 it will be seen that the beam consists of a single bar, sustained on a stand at one end, and enclosed in a guard at the other, while on this beam there rests a semicircular brass box forming a poise. Along the top of the beam, there is cut an exceedingly fine rack; and the motion of the poise is obtained by a pinion placed inside of the box and gearing into this rack. At the end of the beam may be seen the mercury-cups for making an electrical connection as the beam rises and falls. The operation of this piece of apparatus is substantially as follows. The clock-work motor contained in the poise, for driving it to and fro on the beam, is connected with the mercury-cups by means of some brass strips placed in the rear of the beam. These strips are connected with two electro-magnets on the inside of the poise: consequently, when the beam either rises or falls, one or the other of the magnets is excited, the corresponding train of clock-work is thrown into action, and the poise rolls to and fro until a balance is re-established. This motion of the poise to and fro on the beam is exceedingly simple, the knotty part of the problem being to correlate the motion of the poise with the motion of the cylinder exactly, so that, in a given travel of the poise along the beam, the cylinder may move a corresponding quantity. Of course, the ratio between the two movements is simply a matter of proportioning so as to accommodate the ordinary cross-section sheet to the circumference of the cylinder; but an exact and constant ratio is a very important point. Inside of the poise are two large wheels, about eight inches in diameter. The wheel placed in front is graduated with a series of numbers. The pinion carrying the poise along the beam is an inch in circumference, and consequently a single revolution of the pinion carries the poise one inch along the beam. The front wheel is secured directly to the pinion-shaft, so that there can be no back-lash between the two; and, being eight inches in diameter, one revolution of the pinion causes this dial-wheel to travel twenty-five inches of circumference. A motion of one inch along the beam corresponds to a weight of four thousand pounds. The dial-wheel being eight inches in diameter, and subdivided into four hundred parts, each of these parts corresponds to ten thousand pounds. The rear wheel of the poise is constructed in precisely the same manner as the front wheel, excepting that the marks on the dial are replaced by little strips of India-rubber, so that the wheel presents a series of teeth alternately made of India-rubber and of brass. On this wheel, there presses a brass commutator-strip, so arranged as to include the cylinder in its

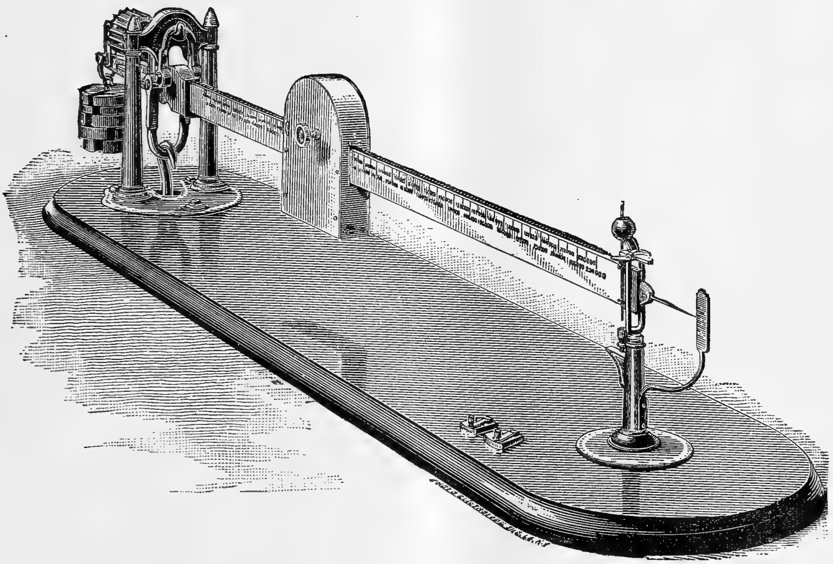


FIG. 3.

electric circuit. As soon as the poise commences to move along the beam, this wheel, with its insulated spaces, commences to turn under its commutator-strip; and with every passage of a tooth under the strip a current passes into the cylinder. Inside of the cylinder are two toothed wheels, mounted on the central shaft, and capable of being ratcheted round by means of a little lever arm and pawl, operated by a magnet placed directly under each of the wheels. locked up in a way to be absolutely exterior to any control on the part of the operator.

An old proverb has said that 'the proof of the pudding is in the eating.' In fig. 5 may be seen a half-dozen curves corresponding to as many test-pieces. The vertical scale gives the stresses, while the horizontal scale gives the normal stretches, of the pieces under examination. The two steel curves bear to each other a strong resemblance. Each commences

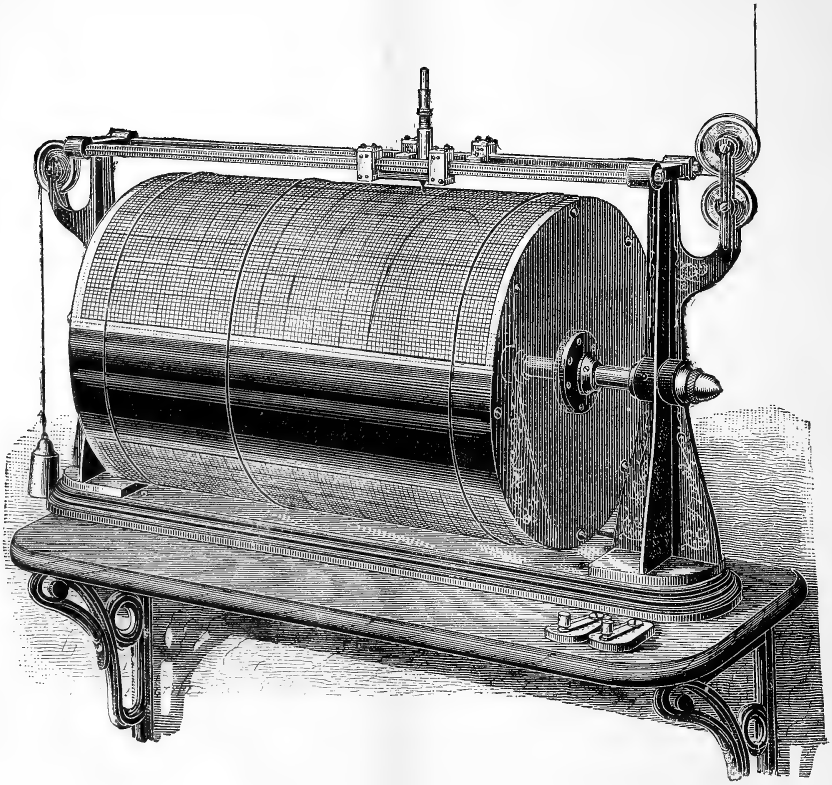


FIG. 4.

One of these wheels is intended to drive the cylinder in one direction, and the other in a contrary. One electro-magnet is connected with the mercury on the bottom of the beam, and the other in the mercury-cup on the top. As a consequence, as soon as the beam makes connection with either cup, the poise commences to travel: the corresponding electro-magnet acts, and rotates the cylinder in one way or the other. The cylinder might be placed in New York, and the registering-cylinder in Cincinnati, and the two work absolutely in harmony with each other: so, should it ever be deemed expedient, the cylinder may be enclosed or with a line slightly inclined to the axis of stress at a constant tangent. As soon as the elastic limit is reached, a sudden point of inflection occurs. Very soon, however, there is a second point of inflection, and the curve takes on a parabolic form. The steel curves, as well as that given by the specimen of Ulster iron, may be taken to be typical forms obtained from the material which is nearly homogeneous. The lines are quite true, and without any special irregularities, until the maximum stress is reached, shortly before the specimen breaks. The stress then commences to decrease, owing to the rapid reduction of area of the piece;

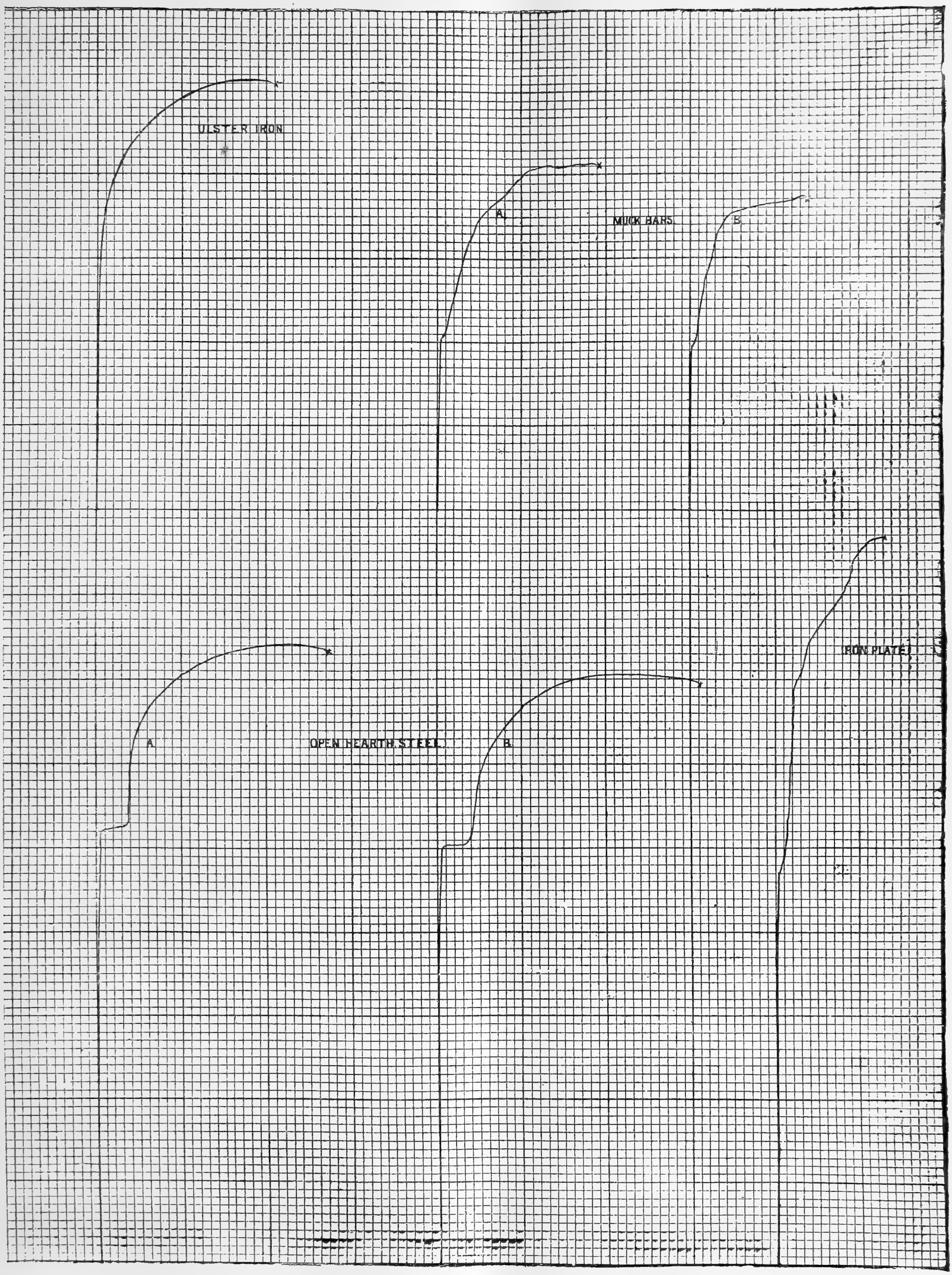


FIG. 5.—AUTOGRAPHIC RECORD ON FAIRBANKS TESTING-MACHINE.
Vertical scale, 10,000 lbs. to the inch; horizontal scale, normal stretch.

and with the reduction of the stress, the curve drops, until very shortly the specimen is ruptured, and the apparatus comes to a standstill. The other three curves are those given by a piece of boiler-plate and of a specimen of muck-bar, and are very good examples of the value of the autographic method. As is well known, both boiler-plate and muck-bar are decidedly non-homogeneous; and as a result we have curves here that are exceedingly irregular, especially after passing the elastic limit. While they bear a general resemblance to the previous ones, they are full of points of inflection, turning and twisting about, and giving one an idea that the specimen consisted of a bundle of threads or fibres which gradually parted under the action of the stress, giving any thing but a constant and uniform action.

In conclusion, a word as to the practical accuracy of the lever testing-machine may not be out of place. The machine under consideration has been subjected to severe use for nearly two years, during which time its sensitiveness, even when loaded, has not risen so high as the least reading on the poise. From this, and from long practice in similar scale-work, it may be safely stated that the testing-machine, with proper care, may have an exceedingly long life. The attainment of absolute accuracy in any department of investigation, would, if it were possible, be an extremely desirable result; yet even our best experiments are simply close approximations to the truth, and it will be granted that it is desirable to make all of our improvements commensurate towards an absolute standard of accuracy. It is of no importance to carry the weighing-power of the testing-machine beyond the possibility of the measurement of the bar. For example: supposing the tests most frequently made are those of bars having about a square inch of cross-section. In a piece of iron an error of a thousandth of a square inch of cross-section corresponds to a possible inaccuracy, in the stress produced on the bar, of fifty pounds; while the corresponding quantity in a steel bar corresponds to about seventy to ninety pounds. There are very few lathes in the country in which it is possible to turn a bar so exactly that it shall be perfectly round, and that there shall be no variation from one end to the other of more than a thousandth of a square inch. There are few men that are capable of manipulating any lathe to produce such a result; and there are still fewer gauges that are capable of measuring even a perfect bar so as to exclude the possibility of an error as great as a thousandth of a square inch. Now, if it be impossible to measure our bars to within an error of fifty to a hundred pounds in the testing-machine, is it of any importance to refine the machine beyond this reading? In the lever system of testing-machines it is perfectly possible to obtain a machine which will uniformly and constantly give readings which shall not have a greater variation than from five to twenty pounds; and, if our bars can only be measured to fifty or a hundred pounds, would it not be wiser to spend money in refining the gauges rather than in refining the machine? Again: when the consideration of the tests on the full-sized members occurs, or bars direct from the rolls, carrying with them the scale, and other imperfections from the mill, the possibility of measuring to a thousandth of a square inch becomes absurd, and two or three hundredths is the nearest approximation that can be made. In making a test of an ordinary I-bar, of, say, five or six inches of cross-section, it is certain that the bar has any thing but an absolutely uniform section from end to end; and how long, may it be asked, would it take to measure that bar from end to end, so that the least cross-section could be obtained for the record? And again: in actual experience it has been frequently found, that, having obtained what is supposed to be the least cross-section, the test-piece may break in a totally different place. It will be conceded that practical engineers care very little for test-records beyond the hundredth's place of figures; and what the country wants at the present time, is not so much testing-machines constructed with a theoretical refinement of accuracy, as a large number of practical machines, so that one may be located in every iron-works in the country, and means to carry on the experiments and to obtain from these machines a practical knowledge of what America's constructive materials really are. A. V. ABBOTT.

NEW METHOD OF MOUNTING REFLECTORS.[1]

IT is well known to all who have given attention to this subject, that the optical performance of great reflecting-telescopes has not been proportional to their size, and that the mechanical difficulties of keeping a large reflector in proper figure in different positions have been apparently insurmountable. A plan of supporting a large mirror, devised by Mr. Henry, has been adopted in Paris, which it is hoped may obviate this difficulty. It consists, in principle, in supporting the mirror upon a

[1] Extracted from a report to the secretary of the navy on improvements in astronomical instruments.

second surface, ground to fit it with accuracy when the mirror is in proper shape. If the mirror rested directly in contact with this second surface, no advantage would be gained, since the backing itself would bend as readily as the mirror. Therefore between the two is inserted a thin stratum of some elastic substance. Mr. Henry has found a fine sheet of flannel to give the best results. The effect of the sheet is to diminish the flexure of the mirror by a fraction depending on its stiffness and on the elasticity of the flannel. Theoretically it may be considered imperfect, because, in order to act, some stiffness is required in the mirror itself. A perfectly flexible mirror would bend just as much with the flannel as without it. But the flexure of the mirror can, it appears to me, be reduced to quite a small fraction of its amount. Moreover, I see no insuperable objection to the superposition of two systems of the kind; the mirror resting upon a stiff disk, which is itself supported upon a second one. This plan has been entirely successful in the cases in which it has been applied. Mirrors up to twelve inches in length show not the slightest flexure when moved into all practical positions. Unfortunately it has not yet been tried with reflectors of a larger size.

SIMON NEWCOMB.

AFTER-IMAGES.

THAT one cannot well contribute to a subject unless he knows something of its literature is illustrated afresh in a painstaking article by Mr. Sydney Hodges, in the October number of the *Nineteenth century*, on 'After-images.' Mr. Hodges has discovered for himself the fact that the after-images of bright objects are in general colored, and that they change color as they gradually fade away in the dark field of vision when the eyes have been covered. He has very carefully observed the phenomena in his own case; and he comes to the conclusion, that, in all cases of such after-images, "the color of the image is produced, not by the tint of the object we look at, but by the amount of light thrown on the retina, either by the greater or less intensity of light in the object itself, or by the amount of time during which one looks at it." This remarkable result is, however, reached by experiments that cannot prove it: for in all of them the conditions are too complex; namely, in all the important cases, our experimenter observed the bright object for a comparatively long time before covering the eyes. The common theory of these phenomena, however, assumes, that, after such a continued observation, the causes of the colors in the after-image are decidedly complex; and their complexity may be such as to render a complete explanation of the phenomena wholly impossible. Therefore the only simple way to begin observing the phenomena is to get instantaneously produced after-images, and to observe the order of colors in them as they disappear: for the common theory is substantially, that the separate nervous elements, whatever they are, that respond to the different wave-lengths, or that produce, when excited, the three primary color-sensations, recover from the after-effects of excitement with different degrees of rapidity, and again, if continuously excited, yield to exhaustion with various degrees of speed; so that the color of the after-image at each instant, since it must depend on the mixture of the different after-effects in the different elements, must vary as these elements return, each at its own rate, to the condition of rest, and must so depend, not only on the rates of recovery of each element, but also upon the degree of exhaustion that each element has undergone during the time of stimulus. Hence the simplest case would be the one where the degree of previous excitement was as nearly as possible equal for the different elements, — a case which would be realized best through momentary stimulus. But if the stimulus is continued ten or twenty seconds, then the after-image will be further affected by the rates at which the different elements have tended to get exhausted; and if these rates are themselves quite different, as is likely, then the after-image will be determined in its successive colors, not only by the different rates of subsidence of excitement in the elements, but by the different degrees of previous exhaustion: and all this may possibly so complicate things as to make the phenomena of the after-image seem wholly out of relation to the color of the original object. And thus any such uniformity as our author notices will be of little worth, unless we know just the conditions of time and illumination, and unless we observe the results with very many persons; and even then the facts may turn out to be too complex for us to explain, so that no light will be thrown by them on the theory of after-images.

All this Mr. Hodges could have found stated or implied in many places. The phenomena have been much observed and discussed. Helmholtz gives the older literature in § 23 of his Physiological optics, and himself declares that it is impossible, by reason of the complexity of the phenomena of fatigue, to give a complete explanation of these phases. Wundt, in the *Physiologische psychologie*, while not agreeing as to the theory with Helmholtz, still holds to an explanation somewhat analogous; and he considers, that, to avoid confusion, one must clearly separate the cases of instantaneous stimulation from the more complex ones, in which, as he implies, fatigue and other causes may affect the phenomena (*Op. cit.*, bd. i., p. 438, of 2d ed.). But of such separation our author is ignorant, and confuses all the phenomena in one mass together; so that observations that might easily have been made really valuable for the theory cannot well be used in their present shape at all, and can only raise in the casual reader's mind a false hope that a law has been found, when, in fact, as it is stated, the supposed law of our author is false, and is at once contradicted by the observation,

added by himself in a footnote, that the "solar spectrum does produce the complementary colors in the after-image." For if the so confidently proclaimed law did not turn out true for saturated colors, the simplest of all perceptions of color, why did not our author suspect that he was on dangerous ground? As for the rest of his article, it is really no contribution to science, but contains an effort to refute the doctrine of fatigue in favor of some quite unintelligible explanation of after-pictures, and to edify the reader by general reflections.

We are far from being fully persuaded of the truth of the common theory, and have nothing ourselves to add to the discussion of the subject, save the present note of warning to solitary observers of mental phenomena. Let us all observe, by all means, and independently; but let us know what other people have said, or at least what the greatest men have said. Mr. Hodges is actually capable of believing and saying, at the outset of his article, such words as these: "I should add, that brief references to after-images with closed eyes may be found in Helmholtz's great work on Physiological optics, in Dr. Foster's Text-book of physiology, and in a few other works; but the fact that neither of them contains any detailed experiments (?) such as I am about to describe, induces me to hope," etc. And this Mr. Hodges could write, presumably with Helmholtz's book, § 23 and all, before him. What he is about to describe we have indicated. He looked at a window, and then covered his eyes; afterwards he tried the sun, colored cards, etc.; then he asked two or three people to try similar experiments; and then he wrote his article. And now who shall say that every intelligent man understands how to use even the best-known and best-arranged books? And why should the pages of the *Nineteenth century* be thus occupied? JOSIAH ROYCE.

LAKES OF THE GREAT BASIN.

As the geological observations given in a recent paper by Prof. E. D. Cope[1] relate to a region somewhat familiar to me, I venture to offer the following comments.

Under the heading of 'Preliminary observations' it is stated that the geologists of the Fortieth-parallel survey have shown that Lake Bonneville existed during tertiary time. It must be known to every one, however, who has read vol. i. of the reports of the survey mentioned, that this lake is there classed as quaternary: it has been so regarded by all geologists who have made any considerable study of the surface geology of Utah. Lake Lahontan is supposed, with good reason, to have been contemporaneous with Lake Bonneville, and therefore also of quaternary age. Recent observations tend to prove that the last great rise of these lakes was later than the greatest extension of the Sierra-Nevada glaciers, and perhaps synchronous with the Champlain epoch of the Atlantic coast.

[1] On the fishes of the recent and pliocene lakes of the western part of the Great Basin, and of the Idaho pliocene lake (*Proc. acad. nat. sc. Philad.*, June, 1883).

Lake Bonneville was not named by the geologists of the Fortieth-parallel survey, as stated by Professor Cope, but was first so designated by Mr. Gilbert.[1]

The list of lakes given as now existing in the Lahontan basin should also include Honey Lake, California, as the valley in which it occurs formed a bay of the old lake with over three hundred feet of water. A map, showing the outline of Lake Lahontan as recently determined, will appear in the third annual report of the U. S. geological survey.

The prediction "that it will be shown that a third lake existed in Oregon, north of the supposed northern boundary of Lake Lahontan," has proved correct only in part. A geological reconnoissance conducted by myself in this region in the spring of 1882 has shown that the Great Basin, north of the hydrographic rim of Lake Lahontan, was divided during quaternary time into not less than ten independent hydrographic areas, each of which held a lake of small size, as compared with Bonneville and Lahontan.

The statement that "the lakes of the Great Basin in Nevada and Oregon diminish in alkalinity as we approach the Sierra Nevada Mountains," meets with a notable exception in Moro Lake, California, which lies at the immediate base of the highest portion of the mountains, but is yet, according to an analysis of its water made for me by Dr. F. W. Taylor, far more alkaline than any of the lakes of the Lahontan basin, excepting the soda-ponds at Ragtown, Nev.

Professor Cope also says, that "the lakes most remote from the mountains are not inhabited by fish, their only animal population being crustacea and the larvae of insects." That this conclusion is too broad is illustrated by the life of Humboldt Lake, which is inhabited by both fish and mollusks, and also that of Ruby and Franklin lakes, situated still farther eastward, which abound in molluscan life. That the freshness of lakes, and consequently their inhabitability by fishes and mollusks, do not depend on their relation to mountains, or even on the existence of an outlet, can be shown by numerous examples in the Great Basin. The only explanation of the apparent anomaly of an enclosed lake of comparative freshness (with less than one per cent of saline matter in solution) in the nearly desiccated basin of a far larger lake, which never overflowed, has been suggested by Mr. Gilbert.[2] His hypothesis is, that such lakes owe their freshness to complete desiccation and the burial of the precipitated salts beneath plaza deposits. When water re-occupies such a basin, the imprisoned salts may not be redissolved. It is evident that this process might take place in any part of an arid region like the Great Basin, whether it be near or remote from mountain ranges.

The locality mentioned on p. 137 as having furnished fossil remains is included within the still distinct beach-lines of an ancient lake which once filled the Christmas Lake and Silver Lake valleys. The shells collected at this locality by myself have been

[1] Wheeler survey, vol. iii. pp. 88, 89.
[2] Second ann. rep. of U. S. geol. surv., p. 177.

examined by Mr. R. Ellsworth Call, who reports the following species: Aphaerium dentalum Haldeman, Pisidium ultramontanum Prime, Helisoma trivolvis Say, Granulus vermicularis Gould, Limnophysa bulimoides Lea, Carnifex Newberryi Lea, Valvata virens Tryon.

The mingling of the blackened and mineralized bones of horses, camels, elephants, edentates, etc., with the shells enumerated above, presents a puzzling association of extinct tertiary(?) mammals with quantities of shells of living species, which we had hoped Professor Cope's studies would elucidate.

The presence of 'worked flints,' mingled with the fossil bones, is a matter of but little significance; as the bones occur on the surface, and might have had arrow-heads, etc., scattered among them at a very recent date. There is no evidence that the fossil animals, and the people who chipped the flints, were contemporaneous.

The valley of the Warner Lakes is referred to as a 'fractured anticlinal.' Again, the same expression is used in describing Silver Lake. We believe, however, that geologists familiar with the progress of exploration in the Far West during the past ten years would class these basins as monoclinal valleys, of the Great Basin type.[1] The Warner valley has a profound fault along both the eastern and western borders, and is enclosed to a great extent by lofty fault-scarps.

The Abert Lake basin also owes its formation to displacements. The lake occurs at the base of a great fault-scarp, forming a cliff two thousand feet high, and covers the depressed edge of a thrown block.

In the passage relating to Abert Lake (p. 138), the reader is left in doubt as to whether the lake, or the Chewaucan River, abounds in trout. Later, however, three species of fish are credited to Abert Lake. My own experience has been, that trout are abundant in the river, and absent from the lake; although they perhaps could exist in the latter in the immediate vicinity of the mouth of the Chewaucan River (frontiersmen who are familiar with the lake say that it is uninhabited by fish). During my own examination I found its waters swarming with 'brine shrimps' and the larvae of insects, but never saw a trace of piscine life. Its waters are strongly alkaline, and utterly unfit for culinary purposes. In its physical properties the water of Abert Lake resembles the brines of Sumner Lake (Oregon), Moro Lake (California), and the soda-ponds (near Ragtown, Nev.), all of which are too strongly alkaline to be inhabited by fishes. It is not evident on what authority Professor Cope ascribes a fish fauna to this lake, as on p. 138 it is stated distinctly that he did not get a near view of it.

From a study of the geographical distribution of the fishes in the lakes of the Great Basin, Professor Cope has found that the larger fishes inhabiting the lakes in northern Nevada and south-eastern Oregon are different from those of the lakes of the Bonneville basin. This is an interesting determination; as the former basins were mostly without outlets during the quaternary, while the latter became tributary to the Columbia.

The effect of alkalinity on the growth of fishes has been noted by Professor Cope to some extent, and is evidently a study that might lead to interesting geological conclusions. The comparison of the faunas of Pyramid and Tahoe lakes would perhaps show the effect of salinity and alkalinity on the species of fishes which probably inhabit both lakes. Pyramid Lake, it will be remembered, is supplied almost wholly by the Truckee River, the outlet of Lake Tahoe.

Before concluding that "all the species of Pyramid Lake are peculiar to it, excepting Catostomus tahoensis," it would be desirable to compare its fishes with those of Walker Lake. As these two lakes are quite similar in chemical composition, and both occur in the Lahontan basin, it seems probable that their abundant faunas would be found nearly identical. One species of trout, at least, seems to the writer, from superficial examination, to be common to the two.

The second part of Professor Cope's paper is devoted to the description of the fossil fauna of 'Idaho Lake.' This lake existed in eastern Oregon and western and southern Idaho during pliocene time. No body of water represents it at present; and the fish-remains found in its sediments differ from those of the Oregon basin, both recent and fossil. The extent of this ancient lake is not known. Its sediments are named the 'Idaho formation,' but no typical exposure is described or in any way indicated. Even the locality at which the fossil bones were collected is, for some unstated reason, withheld. This method is to be regretted; as Professor Cope does not stand alone in making geological divisions on purely paleontological grounds, without attempting to describe or locate the formations named. If this practice is persisted in, it can only lead to confusion.

Of the twenty-two species of fossil fishes described, eight are new. Besides these, the sediments of the Idaho Lake have furnished three species of crawfish which were reported by Professor Cope some years since. The mollusks, it appears, have already been described by F. B. Meek. Both the vertebrate and invertebrate fossils of the formation determine it to be lacustrine and fresh.

Although we have ventured to take exception to a number of statements in the paper under review, yet we welcome it as adding materially to our knowledge in a field that had previously been but little studied.

ISRAEL C. RUSSELL.

Washington, D.C.

[1] See 'Basin Range structure,' Geol. of the Uintah Mountains, Powell, p. 16.

THE DEFINITION OF MEAN SOLAR TIME.[1]

THE proper definition of mean solar time appears to me a very simple matter, and to have nothing arbitrary about it. The mean sun is merely an imaginary body which is supposed to move uniformly

[1] Paper by Prof. J. C. Adams of Cambridge, at the December meeting of the Royal astronomical society. From *The observatory*, February.

in the equator at such a rate that the difference between its right ascension at any time, and that of the true sun, consists entirely of periodic terms. This difference is called the equation of time, which, therefore, by its very nature, cannot contain any term increasing indefinitely with the time. Mean noon at any place is determined by the transit of this imaginary body over the meridian of the place, just as apparent noon is determined by the transit of the true sun.

Thus mean time is defined with reference to a natural phenomenon; viz., the transit of the real sun over a given meridian: and we cannot have one length of a mean solar day according to Bessel, and another length according to LeVerrier, any more than we can have different lengths of the apparent solar day.

A mean solar day, according to Mr. Stone's theory, is something totally different from that above defined. It has no reference to the average length of the apparent solar day, but is purely artificial or conventional in character. Practically, Mr. Stone's mean solar day is the time during which the mean *longitude* of the sun increases by some definite amount. Bessel gives one determination of this amount, and LeVerrier a different one: hence Mr. Stone is obliged to employ two mean solar days, which are of different lengths, according as Bessel's or LeVerrier's mean motion of the sun is used. On this principle, every fresh investigator of the sun's motion would require a mean solar day peculiar to himself. We are tempted to ask, What was the meaning of the mean solar day before Bessel's time?

The origin of Mr. Stone's misapprehension on this point seems to be the following. In the ordinary practice of an observatory it is usual and convenient to deduce the mean solar time from the sidereal time supposed to be known, instead of finding it by direct observation of the sun. In order that this conversion of sidereal into mean solar time, however, may be correctly performed, it is necessary to employ the correct mean longitude of the sun at the given instant. Any error in the assumed mean longitude will produce an equivalent error in the mean time deduced; and, if the sun's mean motion be incorrectly assumed, the error of time thus produced will gradually accumulate.

Thus the error of mean solar time as deduced from sidereal time by means of Bessel's formula, which amounted in the year 1864 to a little more than half a second, has increased to a little more than six-tenths of a second at the present time. The increase of the error of mean solar time in nineteen years is in reality rather less than eight-hundredths of a second, whereas Mr. Stone's theory makes it amount to twenty-seven seconds! In fact, the error, according to Mr. Stone's theory, is about three hundred and sixty-five times as great as it should be. The reason is, that mean time is measured, *not* by the sun's mean motion in *longitude*, as Mr. Stone's theory supposes, but by its mean motion in *hour-angle*, which is about three hundred and sixty-five times as great; so that the error in time produced by a small error in the mean motion in longitude is only about $\frac{1}{365}$ of that which would be produced if the error in time bore the same proportion to the time that the error in the mean motion in longitude bears to this mean motion itself.

If n denote the sun's mean motion in longitude in a mean solar day, then the ratio of the length of a mean solar to that of a sidereal day is

$$360° + n : 360°.$$

And if $n + d\,n$ denote a slightly different determination of the mean motion in longitude, this ratio will be altered to

$$360° + n + d\,n : 360°.$$

Hence the measure of the sidereal interval corresponding to any given number of mean solar days will be altered in the ratio of

$$360° + n + d\,n : 360° + n,$$

or

$$1 + \frac{dn}{360° + n} : 1;$$

that is, since 360° is nearly equal to $365\,n$, the sidereal measure of the interval will be altered nearly in the ratio of

$$1 + \frac{1\,dn}{366\,n} : 1$$

instead of in the ratio of

$$1 + \frac{dn}{n} : 1,$$

as it should be by Mr. Stone's theory.

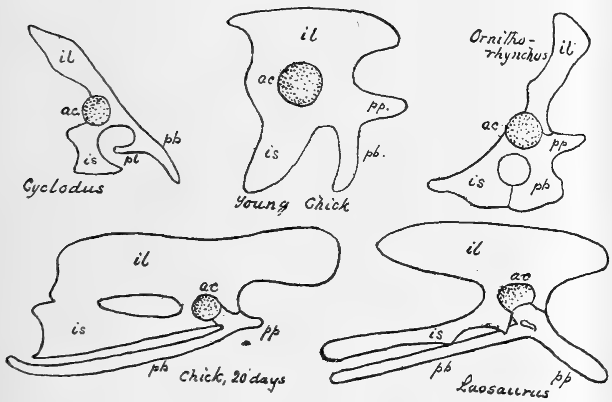
In conclusion, we will test Mr. Stone's theory of mean solar time by supposing an extreme case. Let us imagine that the sun had *no motion* in longitude, but, like a fixed star, retained a constant position in the heavens. On this supposition, mean solar time would be just as intelligible as it is at present, and it is evident that the mean solar day and the sidereal day would become identical with each other; but what would become of mean solar time according to Mr. Stone's idea of it?

MORPHOLOGY OF THE PELVIS AND LEG.

MISS ALICE JOHNSON, at the suggestion of the late F. M. Balfour, has investigated the development of the pelvic girdle and hind-limb of the chick (*Quart. journ. micr. sc.*, xxiii. 399). On the fourth day of incubation the limb is merely a local exaggeration of the Wolffian ridge, consisting, like it, of a mass of rounded mesoblastic cells crowded together. The first trace of the skeletal parts appears on the fifth day; the mesoblastic tissue of the axis of the limb becoming more condensed, and, by the seventh day, converted into recognizable cartilage. Ossification begins very late. The entire skeletal *anlage* of the girdle and limb is at first continuous, making a T, of which the stem represents the limb, and the cross the girdle running dorsoventrally. The pelvic *anlage* soon expands, above the centrally placed acetabular region, into a broad plate, the ileum; below, and in front, into the narrow pubis. A little later the pectineal process grows out in front from the upper part

of the pubis, and the ischium appears behind as a downward expansion below the acetabulum. The further change consists chiefly in the expansion of the ileum, and in the growth of the pubis and ischium; which last two become inclined backward, and acquire a considerable posterior prolongation. During these changes the pelvis passes through a stage which is permanent in Apteryx. The division of the primitive anlage into the skeletal parts is produced by the known histological changes at the joints. The author thinks that Hofmann's 'epipubis' (*Nederl. arch. zool.*, iii.) is the true pubis, and his 'pubis' in reptiles a process of the ischium. She also corrects some errors of Bunge.

These observations throw much light on the homologies of the pubis, of which the pectineal process is a branch, so that the pubis is biramous. A comparison of the bird with mammals (in which the pectineal process is often reduced, and sometimes absent) and dinosaurs at once determines the homologies of the pubis in these forms. In reptiles the pubis has also two branches,—the main body of the pubis; and the



Explanation.—*il*, ileum; *ac*, acetabulum; *is*, ischium; *pb*, pubis; *pl*, processus lateralis; *pp*, pectineal process.

posterior ramus lateralis, which may be wanting, however, as is the case with crocodiles. After discussion of the subject, the writer concludes, we think rightly, that the so-called pubis of reptiles is homologous with the pectineal process, and the lateral ramus homologous with the pubis of higher forms. The homologies are given in the following table, and differ, it will be seen, very widely from those current:—

Reptiles.	Dinosaurs.	Embryo bird.	Birds.	Mammals.
1. Pubis.	Pubis (Marsh).	Anterior branch of pubis.	Pectineal process.	Pectineal process.
2. Processus lateralis.	Postpubis (Marsh).	Posterior branch.	Pubis.	Pubis.

Miss Johnson also investigated the development of the limb. Her observations agree in almost every detail with Baur's (*Morphol. jahrb.*, viii.): we therefore note merely the presence of five metacarpals, and the failure to find a separate origin for the intermedium; but, in opposition to Morse, she is inclined to concur with Baur in describing the ascending process of the astragalus as an outgrowth from the tibiale. Morse's conclusion may be due to his having studied different birds (aquatic species). It is a pleasure to praise this excellent paper.

C. S. Minot.

RECENT WORK ON BRACHIOPODS.

The important though rather fragmentary observations of Kovalevski on the development of the brachiopods have long remained sealed in their original Russian from western naturalists, who have only had access to more or less incomplete synopses of the original. MM. Oehlert and Deniker have prepared for the latest volume of the *Archives de zoologie expérimentale* a careful analysis of the paper in question, illustrated by rough but sufficiently clear figures reproduced from the original. The result is a paper of some twenty pages, which may be obtained separately, and will have a value for all biologists, whatever their position as to the author's theories.

In a note on Terebratula (Centronella) Guerangeri, M. Oehlert signalizes the existence of two or three forms of this genus in the Devonian of Europe. He discusses the relations of Centronella, Leptocoelia, and Renssellaeria, and concludes that they probably represent an arrested development, which would, if carried out, bring them into relations with Waldheimia, and that they should be referred to the same sub-family. The absence of punctation in the test is referred to metamorphism, as in C. Guerangeri all stages were discovered, from impunctate to completely punctate.

The same author, in the *Bulletin de la société géologique de France*, discusses the Devonian Chonetes of western France, where four species are found in the grauwacke and calcaire beds, but are absent in the grits. One of the species, C. tenuicostata, is new, and all are figured; while the characteristics of the genus are thoroughly reviewed.

In the same publication the author describes two new species of Acroculia from the lower Devonian of Mayenne, reviews the genus, and shows that the prior name of Platyceras Conrad, being doubly preoccupied in insects, must give way to Acroculia.

Lingula Norwoodi, from the Cincinnati limestone, is redescribed and figured by U. P. James in the *Cincinnati journal of natural history.*

Glottidia pyramidata Stimpson has been found by Hemphill in South Florida, considerably extending its range, and leading to the suspicion that G. antillarum Reeve, described from the West Indies, may be identical with it.

W. H. Dall.

THE AMERICAN INSTITUTE OF MINING-ENGINEERS.

THE winter meeting was held at Cincinnati, Feb. 19–22, and was not so numerously attended as usual by reason of the flood in the Ohio, which had so interfered with railroad travel during the preceding week as to keep many at home who had expected to be present.

At the first session, on the evening of Tuesday, Feb. 19, the institute was cordially welcomed to Cincinnati by representatives of the city authorities, of the citizens, of the university, of the Ohio mechanics' institute, and of other organizations.

Mr. Robert W. Hunt of Troy, N.Y., president of the institute, returned thanks in behalf of his fellow-members. The remainder of the evening was occupied by Mr. Arthur V. Abbott of New-York City, who delivered a lecture on physical tests of metals, in which he gave a lucid description of the Fairbanks automatic testing-machine at New York. Diagrams of the various parts of the machine were thrown upon the screen, including representations of the novel contrivances employed for the automatic registration of stresses and strains, as well as some of the autographic sheets, which showed how the ultimate tensile strength of short bars differs from that of longer ones of the same material and same cross-section. The machine has a capacity of two hundred thousand pounds for either kind of stress, — tension, compression, torsion, etc. (see p. 312).

The session of Feb. 20 was opened with a paper by Mr. Magnus Troilius of the Midvale steel-works, Philadelphia, describing and advocating the bromide process for determining the sulphur in steel; and this was followed by a supplementary paper, by the same author, giving tables for facilitating the heat-calculations of furnace-gases containing CO_2, CO, CH_4, H, and N.

The next paper, by Mr. George C. Stone of Newark, N.J., was on further determinations of manganese in spiegel, being a continuation of a paper presented at the Troy meeting, in which the results of many analyses of spiegel by different chemists were tabulated, and the comparative value of the chemical processes employed was discussed.

The next paper read was by Dr. T. Sterry Hunt of Montreal, on the apatite deposits of Canada, their distribution, richness, and value, the amount at present annually exported, the economic conditions for mining it, etc.

Mr. Nelson W. Perry of Cincinnati exhibited specimens of a new mineral discovered by him near Ramos, San Luis Potosi, Mex., for which he proposed the name ramosite. Its hardness is nine in the scale, being next to the diamond; its color, black; its specific gravity, 3.83. Mr. Perry also exhibited crystals of topaz found in Mexico, some of which were as much as an inch in diameter, occurring in the unusual matrix, trachyte.

After a paper by Mr. Frank Firmstone of Easton, Penn., on incrustations in pig-iron, a report was made by Dr. Thomas Egleston of the Columbia school of mines, New York, on the bill now pending before Congress to re-establish a commission for testing the strength and other properties of iron, steel, and other materials of construction. He earnestly disclaimed any intention of interfering in any manner with the use of the Emory testing-machine at Watertown (built by the last commission), or of having it removed to any other locality, and urged that all legitimate influence be brought to bear to have the bill passed.

In an elaborate paper by Mr. S. Stoltz of Pittsburg, Penn., on coal-washing, elevating and conveying machinery, the plant employed by him in handling soft coal was explained in detail by the aid of numerous diagrams.

Professor Lord, of the Ohio state university, Columbus, gave the results of analyses of certain Ohio clays.

A paper by Mr. Joseph H. Harris of Philadelphia, on the benefit fund of the Lehigh coal and navigation company, gave a *résumé* of this and various other forms of life and accident insurance for the benefit of miners, and compared the usefulness of the different plans which have been adopted in Pennsylvania; it being a matter of extreme difficulty and delicacy to arrange a plan which works well, in face of the strained relations often existing between the miners and their employers.

The session of Feb. 21 was opened with a lecture by Dr. A. A. Springer of Cincinnati, on torsion, illustrated by diagrams. He was followed by Prof. William L. Dudley of Cincinnati, who explained somewhat minutely the new process of electroplating with iridium, and exhibited specimens of articles so plated.

A paper by Mr. Pedro G. Salom of Thurlow, Penn., giving the results of the analyses and tests of steel used in the U. S. cruisers now building at Chester, Penn., was, by reason of the important and remarkable results obtained, made the special order for the next meeting of the institute.

The officers elected at this meeting were: —

President, James C. Bayless, New-York City; vice-presidents, Eckley B. Coxe (Dufton, Penn.), Thomas Egleston (New York), Edwin C. Pechlur (Cleveland); managers, Edward S. Cook (Pottstown, Penn.), Frank Firmstone (Easton, Penn.), C. W. Maynard (New York); treasurer, T. D. Rand, Philadelphia; secretary, Rossiter W. Raymond, New York; scrutineers, S. T. Williams, J. T. Lewis.

The annual report of the secretary showed a total membership of 1,341, which was largely increased at this meeting.

The meeting was a success, not only in a professional and scientific way, but socially as well. The institute invited its Cincinnati friends to dinner at the Grand Hotel on Wednesday evening; Mr. and Mrs. T. B. Aldrich entertained the institute, at their residence on Mount Auburn, on Thursday evening; the Southern railway provided an excursion to the high bridge over the Kentucky River, with special train of Pullman cars, and lunch, on Friday; and the institute was invited to attend the opera festival to hear Nilsson on Friday evening.

GEOLOGY OF THE GRAND CAÑON.

Tertiary history of the Grand Cañon district. By CLARENCE E. DUTTON. (Monographs U.S. geological survey, ii.) Washington, *Government printing-office*, 1882. 264 p., 42 pl. 4°. Atlas, 23 sh. f°.

THIS work is the second in numerical order, though the first in date of publication, of the monographs of the U. S. geological survey. It is not a geological report in the generally accepted sense of the term, but deals strictly with the physical problems displayed by the Grand Cañon district, and, as its title indicates, principally with that part of its history embraced in the tertiary period, of which the distinguishing feature in this region is denudation on a stupendous scale.

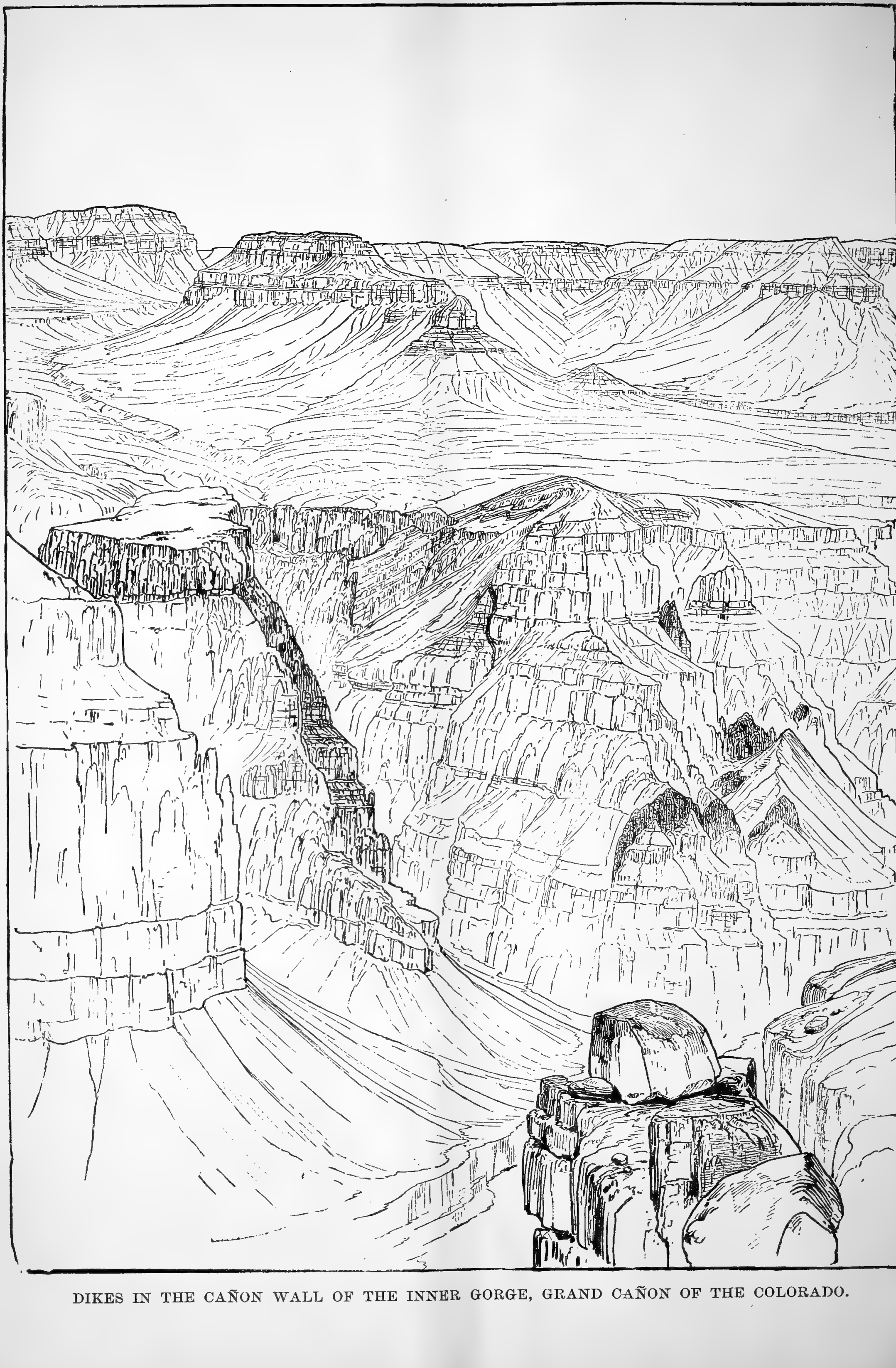
The first geological exploration of the Grand Cañon of the Colorado is due to Major Powell; and for several years his name was closely associated with the progress of discovery in this field. Finding himself, however, unable to continue the work, it was delegated to Capt. Dutton, who had already become familiar with some parts of the district; and the present monograph is the best possible evidence that Major Powell has found no unworthy successor in his investigations.

Capt. Dutton writes as one in love with his subject; and it would indeed be surprising if any geologist who has had the privilege of studying this region were otherwise than enthusiastic in regard to it. A large part of the western territory is such that the geologist who runs may read; that even from the windows of the railway more facts may be gleaned in a day's journey than could be certainly arrived at by months of study in a wooded country, or one mantled by the northern drift. In addition to these advantages, common to vast tracts, the Grand Cañon presents the most striking river-section in America, and perhaps in the world. In such a field a more complete knowledge of the problem is possible, and a closer and more logical method in its treatment admissible, than elsewhere, — circumstances fully taken advantage of in the present report.

The high plateaus of southern Utah descend to the south in a succession of gigantic terraces, composed in succession of the eocene, cretaceous, triassic, and Permian formations, till the summit of the carboniferous is eventually reached. This forms a wide platform, with some approach to regularity of surface, but drops at length in an escarpment of great cliffs to the desert and sierra regions of the farther south and west. The terrace country has a width of from thirty to forty miles, with a length of about one hundred, and forms, as it were, a giant stairway, leading down from the high plateaus, with an elevation of over ten thousand feet, to the carboniferous platform, five thousand feet or more lower. The whole rock series has a preponderant northward dip of an extremely regular character, which seldom exceeds two degrees, and is generally less than one degree, in amount. The carboniferous surface presents a corresponding light slope from south to north; and the strata are traversed by a series of faults and congenetic monoclinal flexures, running in north and south courses, but showing a convexity toward the west. These define the several minor plateaus which diversify the surface; but the region, as a whole, is characterized by the proximate horizontality and undisturbed condition of its rocks, and is in marked contrast to the turmoil of flexed beds found in the adjacent sierra country. Across the carboniferous platform, in a general south-westward course, the great cañon has been cut, — a vast chasm, with a total length of about two hundred miles, a depth of from five thousand to six thousand feet, and a width of from five to twelve miles.

The history of the cañon district, from the later paleozoic to the present day, is naturally divided into two widely contrasted periods; the first extending from early carboniferous time into the eocene, having been one of steady, conformable deposition, bed succeeding bed, till a thickness of about fourteen thousand feet was accumulated. To this succeeded a period of continuous erosion, during which an average thickness of ten thousand feet of the strata was removed from a large part of the surface.

Though rather heterogeneous in character as compared among themselves, the beds of the Grand Cañon region in general closely resemble those representing the same horizons in other parts of the west. The archaean and other basal rocks, not throwing any light in the physical problem proposed in the monograph, are merely mentioned. The carboniferous, broadly viewed, may be characterized as chiefly limestone; and the conditions of a somewhat deep sea at the time of its formation are implied. The Permian and triassic are mainly represented by sandstones, which frequently display cross-bedding, and denote that the water at the time of their deposition was continuously shallow. In the cretaceous, argillaceous and marly rocks become more abundant; and the occurrence of coals and carbonaceous layers throughout, shows that portions of the region became land-surfaces from time to time.



DIKES IN THE CAÑON WALL OF THE INNER GORGE, GRAND CAÑON OF THE COLORADO.

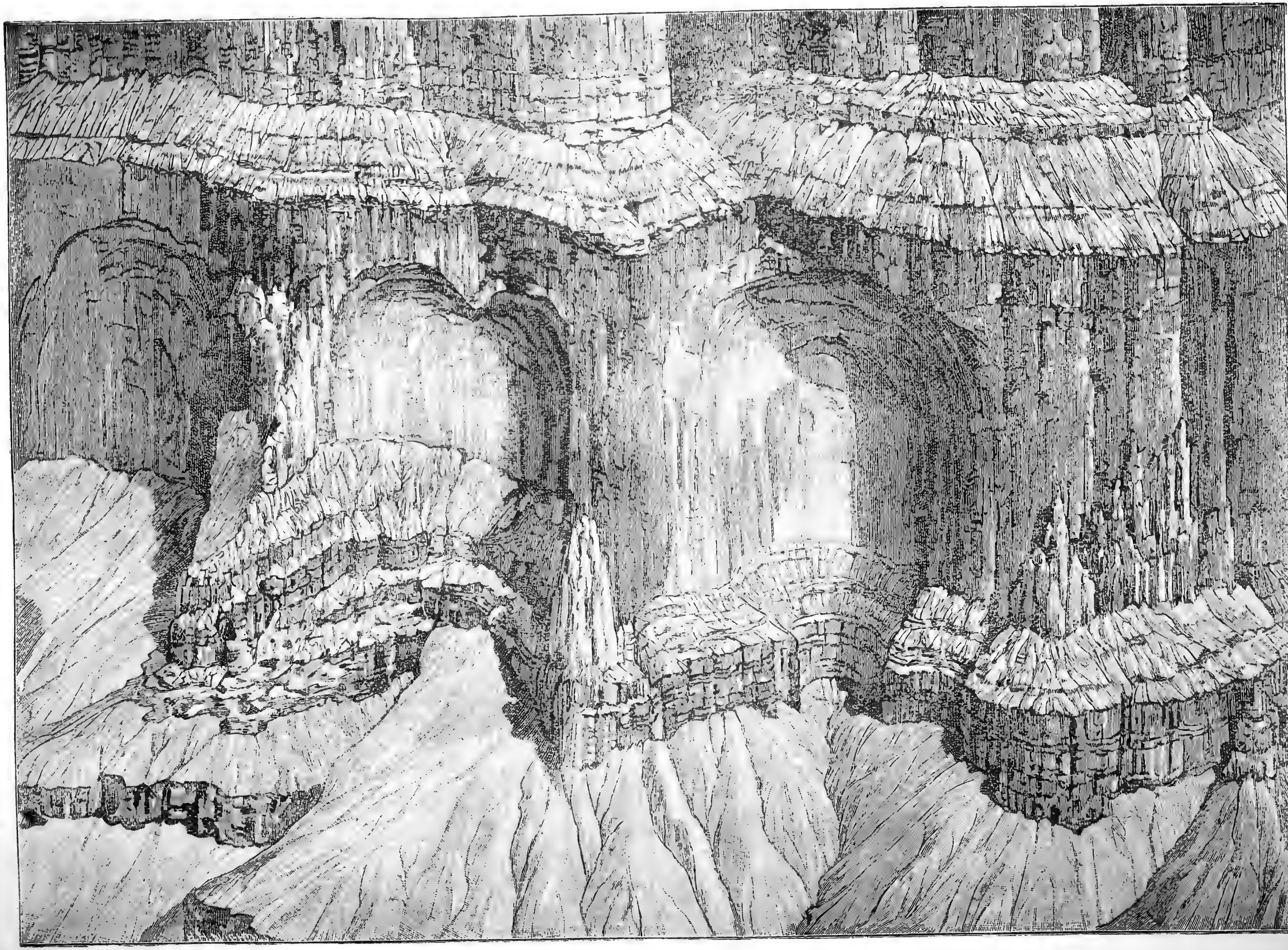
This period closed amid important disturbances; as, in neighboring districts, the succeeding beds are occasionally found to rest directly on the Jura-trias, or basset edges of the cretaceous. As a result of these movements, a great eocene lake was formed, which appears to have been not far above the sea-level, and to have outflowed southward. The change from salt to fresh water conditions is quite sudden. During the eocene period this lake gradually shrank back, and finally disappeared to the north, near the base of the Uinta Mountains, where alone the later eocene deposits are found.

The author finds a little difficulty in explaining the great horizontal similarity in character of the materials laid down during the later periods in a wide expanse of water so persistently shallow. It is suggested, however, that the very shallowness of the sea or lake may, by insuring a constant sectional area, have resulted in maintaining the velocity, and consequent transporting-power, of any currents which existed. The continuance of shallow-water conditions also proves that the profound subsidence required by the volume of the sediments was not acquired suddenly, but that the two increased *pari passu*.

With the eocene the immensely prolonged period of subsidence came to an end, and elevation — shown to have been somewhat spasmodic — and consequent erosion began. It is found by reducing the faults and flexures of the region, and taking into consideration the thickness of the beds, that at this time the carboniferous must have lain over considerable areas, at a depth of from ten thousand to twelve thousand feet below the level of the sea; and it is interesting to remark in passing, that no great degree of alteration appears to have resulted from this deep burial in the earth's crust. The present altitudes of the plateaus mark the difference between the amount of the succeeding uplift and that of denudation; and it is shown that the total movement in elevation has been in different places from twelve thousand to eighteen thousand feet.

The 'great erosion,' as Capt. Dutton names the second period of the history, began at the time of the drainage of the eocene lake, of which there is good reason to believe the Colorado still marks the position of the deepest portion. The immutable permanence in position of the channels of the Colorado and its main tributaries, and the fact that they have been able thus to maintain their original courses in opposition to the superimposed northward dip of the beds, is one of the most striking facts brought out in the study of this district, being, in fact, that which has been most influential in impressing it with its peculiar features. In the latter part of the eocene, and in the miocene, great progress was doubtless made in the removal of the mesozoic strata. The process of elevation continued, and rapid corrasion by numerous streams made steady progress; the Colorado, at this time, probably flowing in a cañon walled by these mesozoic formations, the escarpments of which have now retreated to the terrace district, fifty miles or more to the northward. Through all this lapse of time we are, however, without any very precise data as to the progress of the erosion; and it is not till a date approximately referred to the close of the miocene that any measure of the waste accomplished can be arrived at. The elevation of the district was then for a time arrested; and the streams reached what the author, following Major Powell, calls a 'base level of erosion,' in which, with the production of a uniform light gradient, the wear of their channels clased, and denudation acted only in reducing the probably rough and irregular features of the neighboring country to an approximate level. The Permian strata apparently at this time constituted the actual surface.

About the time at which the Colorado began to cut into the carboniferous rocks, a climatic change occurred, which resulted in producing very arid conditions, and dried up the smaller streams to their sources. This, from what is elsewhere known of the western tertiary, is presumed, with great probability, to be synchronous with the close of the miocene and beginning of the pliocene. Nearly contemporaneous with these events was an uplift of two thousand to three thousand feet, and the outpouring of the earlier basalts, which, forming protective cappings, have preserved portions of the Permian surface above alluded to. The great faults, also, about this epoch first betray their existence; though it is by no means certain that all were then formed, and the evidence is clear that their throw subsequently continued to increase gradually. Corrasion, or the wear by the rivers of these beds, now again became active, but only in the case of the larger streams, which, by reason of their origin in high, well-watered uplands beyond the cañon district, had been enabled to survive. A base level was soon again reached: and the Colorado remained during the greater part of the pliocene at the level of what Capt. Dutton calls the esplanade, or wide upper valley of the present cañon; which valley continued to increase laterally, but not in depth, till the



NICHES OR PANELS (OVER 600 FEET HIGH) IN THE RED WALL LIMESTONE, GRAND CAÑON OF THE COLORADO.

final paroxysm of upheaval set in, producing a further rise of from three thousand to four thousand feet. The faults, which are strictly correlated with the varying uplifts of the several minor plateaus, again increased their displacement; and at the same time, or shortly afterward, the volcanic forces resumed their activity, producing cones of eruption which still display their characteristic form. These, and the lavas erupted from them, afford evidence, that, though the cañon had at the time a considerable depth, the greater part of its excavation still remained to be affected by that last great effort of corrasive action which has only lately come to an end.

It is believed that the elevation of the plateau region has now ceased, and that the rivers have again nearly reached a base level of erosion. Some, at least, of the faults cut the older basalts; but no evidence has been found, where the newer lavas cross them, of any renewed movement. The glacial period passed over this region without leaving any traces of ice-action, manifesting its occurrence merely as a pluvial episode, very brief in comparison with the stages of the great erosion, but of which some effects may nevertheless be traced.

Such is a very brief and necessarily imperfect outline of the train of reasoning in which the author follows out the exceptional processes which have acted in the Grand Cañon district, and eventuated in producing its present remarkable features. Very few of the conclusions arrived at are open to any question; and, though it has been for so short a time known to science, it may be considered as one of the most fully thought out of geological problems. Among the collateral facts illustrated in this region are several, which, from their apparently anomalous character, are of special interest to the student of dynamical geology. Such is the want of coincidence between the great faults and points of volcanic eruption, the bending-*down* of the strata along the dropped sides of the faults, the connection of the latter with the peculiar monoclinal flexures, the not uncommon reversal in direction of throw in the opposite ends of a single fault, and the remarkable observation that the general light dip of the strata is increased notably at the bases of the terraces. The last-named circumstance the author is disposed to connect, though doubtfully, with the theory of plastic equilibrium in the earth's crust, — a theory which we believe few geologists will be ready to follow so far.

A notice of this monograph would be incomplete without special reference to the accompanying atlas, containing geological maps and panoramic views of the district. The latter, together with a number of illustrations in the volume itself, are from the pencil of Mr. W. H. Holmes, and convey a better idea of the proportions and intricacy of the physical features than could be accomplished by any word-painting, however elaborate.

If the character of the critic must be maintained in reviewing this work, which in its main features demands our praise alone, it may be suggested that the 'effusive' style adopted in some of the chapters is scarcely in keeping with the incomparable dignity of the subject, and is not likely to appeal to the specialists for whom this class of publication is intended.

THE BACILLUS OF BERIBERI.

Etiologia e genesis do beriberi. Pelo Dr. J. B. de Lacerda. Rio de Janeiro, *Faro & Lino*, 1884. 68 p., illustr. 8°.

This pamphlet gives the results of a medico-biological study, carried on in the physiological laboratory of the National museum of Rio de Janeiro, on a very obscure disease, which, introduced many years ago in Brazil from India, carries off annually a large number of victims, particularly in the northern provinces of the empire.

Employing the method of Pasteur, and introducing blood of beriberi patients in meat-solution, Dr. Lacerda obtained in numerous experiments a microphyte similar in form to the bacillus of carbuncle. This organism, which reproduces itself by segmentation and by spores, was also found in the fresh urine and blood of beriberi patients, the spores being at times extremely abundant in the blood. On making subcutaneous injections of the liquid in which the organisms were cultivated, in rabbits and guinea-pigs, these animals were found to succumb in periods of from five to twenty days, some of them presenting a true paralysis of the posterior members; others, a notable weakening of these members, with difficulty of locomotion, and loss of cutaneous sensibility. Death in many cases was caused by asphyxia, the paralysis having extended to the anterior members. The cultivated blood of these animals reproduced the same microphytes that had been obtained from the blood of beriberi patients. The microscopic examination of the spinal medulla and of the muscles revealed the presence of the microphyte and of its spores, their abundance in the medulla being especially remarkable.

From these facts the author draws the logical conclusion, that beriberi is a parasitic disease, and that the parasites attack particularly the blood, muscles, and medulla. In seeking the origin of the parasite, it was found that similar organisms were found at times in rice-grains. The characteristics of the grains of rice attacked by the parasite are given; and the hypothesis is advanced, that rice is often the vehicle of the microphyte by which it enters the human system, which appears to be in accord with the fact that rice is a principal article of food in the regions subject to the disease.

Contaminated grains of rice, subjected to the same cultivation as the blood of beriberi patients, produced organisms entirely identical in appearance. Injections of the liquid of the rice-culture in guinea-pigs produced death in thirteen, seventeen, and twenty days, with paralytic phenomena, and death by asphyxia; and the microscopic examination of the spinal medulla and muscles showed the presence of the same organisms found in animals inoculated with the blood-culture of beriberi. The author proposes to continue his investigation of the suspected relation between a rice diet and beriberi.

BIOLOGICAL THEORIES OF AN ARTIST.

Morphology. Estimates of intelligence. Vital chemistry. By FRANK B. SCOTT, artist. Buffalo, *Bigelow pr.*, 1883. 16 p. 8°.

THE author says in his preface, "If we fail in proving the truth of what we advance, our labor will not be lost: we may lead the way to further discoveries. Columbus was mistaken in his seeking another way to India, but his mistake led to the discovery of a new continent." In science great continents of knowledge never have been discovered by ignorant adventurers: we therefore do not believe that Mr. Scott will achieve the important success he dreams of, although he is mistaken in perhaps half his statements. We are acquainted with no other publication, purporting to be scientific, which contains so many amusing errors and entertaining hypotheses in so few pages. We need only give the following extracts in our justification. "Without oxygen, hydrogen, nitrogen, and carbon, we have no knowledge of life. . . . There are other elements subordinate to these. There is also some other element not subordinate. . . . Perhaps this fifth element was the *quint*-essence of the ancients. Huxley, in his 'Biology,' calls it electricity." Will the author kindly refer us to authority on the quintessence of life of the ancients; also to the page of Huxley? He further states that the blood at one moment is red with oxygen; the next, black with carbon. We have no doubt that sufficient carbon might blacken the blood, but we are surprised to learn that the mixture occurs regularly during life. The whole pamphlet resembles these samples.

THE ILLINOIS GEOLOGICAL REPORT.

Geological survey of Illinois. A. H. WORTHEN, director. Vol. vii., Geology and paleontology. Springfield, *State*, 1883. 4+373 p., 31 pl. 8°.

THE first two volumes of this series of reports appeared in 1866; and the others have followed at intervals since then, the seventh having appeared during the past year. The leading feature of these reports is paleontology, in connection with which the names of some of the ablest American paleontologists appear.

In his preface to the present volume, Mr. Worthen says, that to complete the paleontology of the state upon the plan originally contemplated will require two volumes more, with from forty to fifty plates of illustrations each, but that this cannot be done until authorized by special legislative act. It is not improbable, therefore, that the present volume will be the last of the series.

Mr. Worthen's chapter, of fifty-one pages, on economic geology, treats mainly of local sections in different parts of the state, principally of coal-measure strata. He announces the discovery of 'coal-oil' in the town of Litchfield, — a dense lubricating-oil, mingled with salt water, which he thinks comes from the base of the coal-measure conglomerate, or one of the upper Chester sandstones.

Four borings have reached the oil at a depth of nearly seven hundred feet, each boring yielding about two barrels of crude oil per day. He also reports the discovery of brine in Perry county. Six borings have been made, each flowing sixteen gallons a minute, from which an aggregate of thirty-five hundred barrels of salt is made annually.

The work on the fossil fishes by Orestes St. John and Mr. Worthen is a very important one, embracing two hundred and eight pages and twenty-six plates. It treats of those characteristic carboniferous families, the Cochliodontidae and Psammodontidae, and also of Ichthyodorulites. The important works on similar fossil fishes, which were published in previous volumes, are well known; and yet the material now published is unexpectedly comprehensive as regards the variety of forms

embraced in the two families just named. The authors describe and figure fifty-six new species of the Cochliodontidae, together with eight species previously published. They embrace, in all, fourteen genera, six of which are new; namely, Vaticinodus, Stenopterodus, Chitonodus, Deltodopsis, Orthopleurodus, and Taenodus. The last is a hitherto unpublished name, proposed by de Koninck. Of the Psammodontidae, thirteen species (eleven new) are described and figured; eleven of them being referred to Psammodus, and two to Copodus. Eleven genera are recognized among the Ichthyodorulites, one of which, Eunemacanthus, they propose as new. Of these genera, they describe and figure twenty-two species, only two of which have before been published. The specific and generic descriptions are full and clear, and Mr. St. John has made good use of his large experience in their discussion.

Pages 269–322 and four plates are devoted to descriptions and figures of fifty-five species of crinoids, together with a few carboniferous shells. Descriptions of all these except one of the shells were published by Mr. Worthen, without illustrations, in 1882, in Bulletin No. 1 of the Illinois state museum of natural history.

On pp. 323–326 he describes eight species of carboniferous mollusca without illustrations.

Pages 327–338 and one plate are occupied by Worthen and S. A. Miller's descriptions and illustrations of nine forms of echinoderms. Their material for this study was imperfect, and yet they have proposed five new genera; namely, Compsaster, Cholaster, Tremaster, Hybochinus, and Echinodiscus. The latter they refer to the Agelacrinidae, together with Archaeocidaris.

Pages 341–357 are occupied by Mr. Charles A. Wachsmuth. He figures and redescribes, in this volume, two echinoderms which he had previously described in the bulletin of the Illinois state museum of natural history. Following this, he gives an important discussion of certain blastoids, with a description of a new genus, namely, Heteroschisma.

The text of the volume closes with descriptions of three new species of blastoids by Prof. W. H. Barris. They are, however, without illustrations, except one woodcut. Professor Barris refers one of these species to Pentremites Say, and the other two to Elaeacrinus Roemer. He rejects the generic name Nucleocrinus Conrad, because of the erroneous description which Conrad gave of it. Nucleocrinus is, without doubt, identical with Elaeacrinus; but unfortunately Conrad's type specimen, which is still extant, shows plainly that he mistook its base for its summit. Diagnoses are seldom perfect, and it is difficult to determine how much of error we ought to overlook in the retention of imperfectly defined genera.

The letterpress and binding of this book are creditable; but the illustrations are not up to that standard of excellence which was attained in the previous volumes, and which the present state of art demands. Still, they serve well for the identification of the objects which they are intended to illustrate. The make-up of the book has one inexcusable deficiency, which was, no doubt, due to an oversight, since the other volumes are free from this defect. We refer to the absence of any table of contents, or any reference in the index to the different authors, or the titles of their subjects. This does not detract from the merit of the work, however, which is, as a whole, very great; and the people of Illinois may well be proud of what has been accomplished by their geological survey, even if it should now be suspended.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Work in the District of Columbia. — It is intended to map about three hundred square miles of the region about Washington, including the District of Columbia and adjacent country on the north, east, and west, extending to a distance of about ten miles from the district boundaries in those directions. This map will be used for the delineation of the geological features of the district and adjacent country, the investigation of which has been carried on for some time by Mr. W. H. McGee. The topographic work done so far consists mainly of the compilation and transferrence of material furnished by the Coast and geodetic survey in the form of original unpublished sheets upon a scale of 1–15,000, with contours twenty feet apart vertically, and covering the greater part of the area required for the immediate use of the geologist. Mr. S. H. Bodfish has been assigned to the topographic work, and will utilize all work previously done in the area above indicated by the coast-survey and the commissioners of the district.

Springs of Florida. — Prof. L. C. Johnson, while working in Florida during January, gave some attention to the springs and wells in the vicinity of

Jacksonville. He says that within five miles of Jacksonville is a remarkable spring, known as the Moncrief spring, the waters of which seem to be identical with those of the excavation at the city water-works and of many of the springs of this portion of the state. They differ from those of the southern and western portions in being more decidedly chalybeate. In temperature they are decidedly similar. All those near Jacksonville have temperatures of 72° F., and are said to be almost invariable, summer and winter. The extreme range is two degrees; that is, from 72° to 74°. The deep wells, the shallow ones, and also several lake-like springs, all register 72° F. Some are in superficial strata, reaching a depth of only fifteen or twenty feet; others are from thirty to forty feet deep in clay and rock; and some artesian wells penetrate to two hundred feet.

Chemical division. — During January and February Prof. F. W. Clarke and Dr. T. H. Chatard have been busy in the analyses of mineral waters. Among them, Professor Clarke has examined water from the Helena hot-springs of Helena, Montana Territory, which is an alkaline saline water, and water from the warm springs of Livingston, Montana, which is a calcic sulphur-water. Both are thermal, and these are probably the first analyses ever made of them. Dr. Thomas Chatard has also finished some analyses of Damourite from the well-known topaz locality at Stoneham, Me.

At New Haven, Messrs. Barus and Hallock, during January, were engaged in experiments to determine the exact boiling-point of zinc.

The north wind of California. — Mr. Gilbert Thompson, while engaged in topographical researches in the Cascade-range section of California, has been incidentally collecting information concerning what is generally observed as the 'north wind of California,' as it was first observed in that state, and supposed to be local. The name, however, should not be so restricted, as it should be extended to the Pacific slope of the United States and possibly of North America. The characteristics of this wind have been more particularly described by Dr. J. H. C. Bonté, of the University of California, than by any one else. To describe them briefly, they are included under the head of excessive drying-qualities. These are marked both in summer and in winter. In the former, vegetation sometimes appears as though it were burnt, and the effect upon both animals and men is striking. Men who have recently arrived in the country, and are robust, are not so sensitive to the wind as residents; and it has therefore been said that the imagination has a great deal to do with it, but this is a mistake. It matters not whether the wind is hot or cold, it produces a feeling of great depression and nervous irritability, lassitude, and restlessness. Some call it the 'poison wind,' and others the 'crazy wind.' The effects produced are similar to those of the 'Puna wind' of Peru, and the 'Hammattan' of Africa. It blows at no regular interval, nor for any known definite periods. There is some local authority, however, for the opinion that some multiple of three has been observed by some of its recurrences. The wind is really vicious only once in eight or ten years; and it undoubtedly has a powerful and favorable effect in drying up the wet soil, and neutralizing the effects of the rank vegetation, in the Sacramento valley after the rainy seasons. Mr. Thompson has, so far, traced its course and width to latitude 42°; and such information as he possesses to date seems to indicate that the wind moves down along the east base of the Cascade range, and thence through the Sacramento and San Joaquin valleys of California. There are numerous theories as to its origin, and the reasons why it produces such marked and peculiar effects.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of natural sciences, Philadelphia.

Feb. 12. — Dr. N. Roe Bradner exhibited an inscribed stone found inside a skull taken from one of the ancient mounds at Newark, O., in 1865. An exploration of the region had been undertaken in consequence of the finding of stones bearing markings somewhat resembling Hebrew letters, in the hope of finding other specimens of a like character. The exploration was supposed to have been entirely unproductive of such objects, until Dr. Bradner had found the engraved stone now exhibited in a skull which had been given to him. The specimen is of a dark reddish material, of a rounded wedge shape, and bears on its surface a number of characters, the significance of which had not been determined, but which resemble the markings on the specimens before discovered. —— Rev. H. C. McCook described the nests of a new species of spider recently received from Mr. W. G. Wright of San Bernardino, Cal., for which he proposed the name Segestria canites. The cocoons hang in strings from the limbs of trees extending over a pathway. They are placed one above the other to the number of eight, and are united by a netting of white silk, covered with the leaves of the neighboring plants. They are kept in place over the path by lines which extend to either side, sometimes to a distance of five feet. Along one side of the suspended nests is a tube, which is inhabited by the mature spiders. As the weaving of nests over pathways leads to their being frequently torn away by passing animals, it had been suggested that the case was an illustration of a weakening of the instinct of preservation. It may, however, be rather a means adopted for the distribution of the species; the spiderlings being doubtless carried to remote points by the animals which tear away the nests. —— Mr. Edward Potts reported that he had examined the fore-bay at Fairmount water-works, from

which the water had been temporarily withdrawn, with a view to discover the winter condition of the fresh-water sponges and other inhabitants of that locality. Where the surface could be reached, it was found to be covered with a mud-colored incrustation of considerable thickness, which proved to be composed almost wholly of the statoblasts and spicules of the sponge Meyenia Leidyi. Some few fragments of Meyenia fluviatilis and Spongilla fragilis were seen, but the first named was clearly the prevailing species. A disused sluice-way was covered with a dry incrustation of the same material. While considering the effect of the presence of so large a sponge-growth at the inlet to the supply-pumps, Mr. Potts stated that Meyenia Leidyi was conspicuous among the known North-American sponges by its great relative density, and the small proportion of its sarcode or flesh. Its decay, therefore, at the termination of its period of summer growth, would be a slighter cause of pollution to the water-supply than that of any other species. He was, moreover, inclined to believe that decay was not the normal or necessary result of the close of each season's growth. The fragile branches of some species inhabiting exposed situations may, of course, be broken off and destroyed while the sarcode still covers them; but in the sessile portions, and in all when sufficiently protected, the cells of the sarcode at the period of full maturity, forsaking their places along the line of the skeleton framework, gather together by simultaneous amoeboid movement into dense groups, where they are soon covered by a tough chitinous coat, which, in turn, generally becomes surrounded by a crust of minute granular cells, and armor-plated by a series of protective spicules. These groups are now recognized as the statoblasts, gemmules, or winter eggs of the sponge. They are eggs only in appearance, being in reality the resting-spores or protected germs which conserve the life of the individual through the cold of winter. This life-history indicates rather a condensation than a decay of substance as winter approaches, and leaves little or no reason to regard such organisms as a source of water-pollution.

Feb. 19. — Mr. Thomas Meehan exhibited twigs of the plant used by the Piutes and other western tribes of Indians for making baskets. They proved, on examination, to belong to Apocynum cannabinum, the species used by the eastern Indians for a like purpose. —— Mr. Meehan called attention to sections of trees from Schuylkill county, Penn., illustrating remarkably slow growth. A black oak, Quercus tinctoria, in a little over two inches from the centre, had an average of thirty-six circles to an inch; one of hemlock spruce, fifty-one circles to an inch; and one of the common chestnut, twenty-four circles to an inch. Though only four inches in diameter, the oak stem was seventy-six years old; the hemlock, four inches in diameter, was one hundred and four years old; and the chestnut had grown only four and a half inches in diameter in sixty years. He believed two hundred years to be the full average duration of most of the trees of the eastern United States. —— The same speaker, referring to the supposed parasitic nature of the snow-plant Sarcodes sanguinea, of the Rocky Mountains, stated that he had carefully examined a specimen growing at an elevation in the Yosemite Valley, and found it to be existing independently, no connection being traceable with either living or dead roots. No trace of vegetation was found in the soil which was carefully washed away, but a huge mass of coralline fleshy matter, out of which the inflorescence arose. The origin of this fleshy mass was yet an unsolved mystery. From analogy with the behavior of other plants, he was inclined to believe that there was some parasitic attachment in the early life of the plant, and that it stored up in this coralline mass enough nutrition in one season to support the inflorescence, after which the connection was severed. —— Mr. Meehan also exhibited the dried leaves and fruit of Halesia diptera, H. tetraptera, and of a remarkable departure raised from the last-named species some years ago. This appeared in a bed of seedlings, all raised from seed gathered from one tree growing in a garden in Germantown. It attracted attention, when one year old, by the leaves bearing a resemblance to those of an apple-tree. The original tree had leaves narrowly lanceolate and acuminate, rather thin, pale green on the upper surface, and with no particularly prominent veins. The plant in question had broadly ovate leaves, scarcely pointed, very dark green, rugose on the upper surface, and strongly veined and hirsute below. The flowers, when they appeared, were open cup-shaped, instead of being drawn into a narrow tube at the base, as in the parent plant; and the pistil was wholly enclosed, and not exserted. For several years the plant was sterile; and many good botanists, whose attention was called to it, regarded the plant as a hybrid, and the sterility as a proof thereof. It was of no avail to point out that there was no other species from which the parent could have obtained pollen within many miles, nor to show that hybrids were not necessarily sterile. This season, however, the plant produced fruit. It is very small, not much over a quarter of an inch in diameter, and the four equal wings are comparatively large and of a strongly coriaceous character. The fruit which had been cut open was found to have perfect seeds. If the plant, with these leaves, flowers, and fruit, had been found in a state of nature, the botanists would surely have considered it the representative of a distinct species, if not of a new genus. While the suggestion of hybridity might be reasonably excluded, change of surroundings could not be advanced as the cause of the variation, for the environment was precisely the same for the sport, the seedlings which grew without change, and the parent stock. —— Professor Angelo Heilprin stated that among a small number of carboniferous fossils obtained from the border of Wise county, Tex., and submitted to him for examination by Mr. G. Howard Parker, a form occurs which can unhesitatingly be referred to the genus Ammonites. Only a fragment of a single individual is to be found; and this, unfortunately, has lost the shell, so that no external ornamentation, if any such existed, can now be discerned. This is the first Ammonites that has been detected in any Amer-

ican formation below the mesozoic series. The association with it of characteristic paleozoic forms of life, such as Zaphrentis, Phillipsia, Bellerophon, Conularia, Chonetes, and Productus, leaves no doubt as to its position; and hence we must conclude that here, as well as in India, where Waagen first announced the occurrence of true carboniferous ammonitic forms, the distribution of this highly characteristic group of organisms was not so rigidly defined by the mesozoic line as geologists had been led to conclude. That pre-mesozoic Ammonites will be discovered elsewhere besides in India and Texas, there is no reason to doubt; indeed, no assumption could be more illogical than the contrary: and therefore the present discovery is in no way specially surprising, and only interesting rather than important. Special interest, however, attaches to this form; as through it, and the individuals or fragments that have been found in the Tejon (tertiary) rocks of California, we have established in this country the extreme range of the group which it represents. The name Ammonites Parkeri was proposed for the species.

Philosophical society, Washington.

Feb. 2. — Prof. C. V. Riley presented a review of recent progress in economic entomology; describing especially the development of insecticide methods and apparatus, and closing his remarks with a plea for applied science. —— Dr. Swan M. Burnett discussed the question, why the eyes of animals shine in the dark, giving a short digest of the subject, and describing experiments of his own. He concluded that the phenomenon was caused by reflection from the retina of the eye. It is seen best when the observer is on the line connecting the shining eye with a source of light, and ceases when his station departs from that line by a certain amount. The limiting angle (measured at the reflecting eye) is relatively great in the case of eyes which are hypermetropic. Professor William Harkness pointed out that the limiting angle is likewise affected by the magnitude of the bright image on the retina. —— Mr. A. B. Johnson spoke on eccentricities of ocean-currents as illustrated by the voyages of lost buoys. At various times buoys have been torn from their moorings in the waters of the United States, and carried to sea; and eleven of these have been afterward found at distant points, and identified by means of letters cast in their constituent plates. One was found on the west coast of Ireland; a second, at Pendeen Cove, England; two others, just east of Teneriffe; a fifth, near Turk's Island; and a sixth and seventh, near Bermuda. The remainder were found in the open Atlantic, in the following positions: latitude 42° 22′, longitude 26° 38′; latitude 29° 46′, longitude 77° 38′; latitude 30° 30′, longitude 28° 40′; latitude 24° 11′, longitude 32° 43′. Admiral Jenkins cited another instance of a U. S. buoy stranding on the coast of Ireland. In the discussion which ensued, the opinion was expressed by Dr. William H. Dall and others, that the buoys found near Teneriffe had made a northward *détour*, and that those picked up near Bermuda and Turk's Island might have continued on the same course, and afterwards turned west, completing the circuit of the Sargossa Sea; but it was thought more probable that the latter had followed the southward coastwise current inside the Gulf Stream.

Feb. 16. — Prof. F. W. Clarke spoke on the periodic law of chemical elements, giving the history of the discovery of the law and of its verification by the subsequent discovery of elements indicated by it, and even specifically predicted. He exhibited an enlarged copy of Meyer's atomic-volume curve drawn with the latest values for atomic weights and specific gravities, and presented a similar curve illustrating the connection between atomic weight and melting-point. Each curve presents a series of maxima and minima, the maxima of one corresponding to the minima of the other. The regularities of these curves indicate that the elements originated by some method of evolution, and that a feature of transmutation of one element into another is not impossible. —— Mr. Henry A. Hazen read a paper on the sun-glows, which has since been printed in the March number of the *American journal of science.* The first appearance of the phenomenon was at Mauritius, Aug. 28, 1883; and it was next seen at Maranham, Brazil, Aug. 30. It then appeared at irregular intervals on either side of the equator, until Nov. 26 and 27, when it seemed to burst out over the whole world. After describing the nature of the phenomena, and stating the principal theories which had been advanced to account for them, he proceeded to advocate the vapor theory as follows: *a.* The glows are precisely like the ordinary sunset phenomena, which are known to be caused by the presence of aqueous vapor; *b.* The abundance of the material so uniformly distributed accords with the universality of the glows; *c.* The fact that faint stars and clusters could be easily seen indicates that nothing more opaque than water-vapor or frost-particles could be in suspension; *d.* Frost-particles might be repelled to a great height above the earth, and might be kept there by some form of electrical action; *e.* The fact of the spectroscope giving no indication of an abundance of moisture does not militate against this theory, because it has been shown that ice-crystals or frost-particles do not affect the spectrum in a rainband spectroscope. To the volcanic-ash theory he opposed the following objections: 1°. On this theory there must have been sufficient material ejected from Krakatoa, on Aug. 26 and 27, to cover more than a hundred and thirty-five million square miles of the earth's surface; 2°. There must have been currents of nearly equal force, moving *in opposite directions* from the volcano; 3°. The upper currents must have had a sufficient velocity to carry the ashes twelve thousand miles in a hundred and fifty hours (about eighty miles per hour) toward the west, while meteorology indicates no such velocities, and in general shows the upper current to be always toward the east; 4°. The ashes must have been mechanically distributed over the whole earth by air-currents; 5°. The phenomenon has been markedly intermittent; 6°. Volcanic ashes

are more or less opaque, while the phenomena attendant upon the glows indicate no such opacity. The cosmic-dust theory incurs many of the same objections, besides being inherently improbable. In the ensuing discussion Prof. E. B. Elliott argued that the phenomena were electrical; and Prof. H. M. Paul sustained the volcanic-ash theory, pointing out that Mr. Hazen's conclusion as to the simultaneousness of the first appearance of the phenomenon at remote points depended on a special interpretation of imperfections of the record, depending on cloudiness, and claiming the equal privilege of interpreting them in another way.

Ottawa field-naturalists' club, Canada.

Feb. 28. — Dr. George M. Dawson read a paper on the occurrence of phosphate deposits. After showing that phosphatic materials were essential to the life both of plants and animals, he pointed out that the natural cycle of the rotation of these substances was interrupted by the action of man, and that large quantities of matter which should return to the soil were withdrawn from it and taken elsewhere. The cropping of the soil impoverishes it, and prevents it from yielding as abundantly as formerly, unless the loss is compensated by the application of phosphatic fertilizers. The grain exported from the port of Montreal in a single year has been estimated to contain 2,574 tons of phosphoric acid, which implies the total exhaustion, in as far as phosphates are concerned, of 75,000 acres of good land, to renew which would necessitate the application of some 6,000 tons of apatite. It is easily seen that there must always be, under the present condition of affairs, an extensive demand for phosphatic materials; and it becomes necessary to inquire where specially concentrated natural sources of supply may be found. The occurrence of such deposits was traced from the guano, which accumulates in exceptionally dry climates, on islands frequented by immense numbers of sea-birds, and such recent deposits as the 'mussel muds' of Prince Edward Island, through the so-called coprolite beds of England, Carolina, and elsewhere, to the more concentrated and metamorphosed deposits found in the older rocks of Canada and Norway. The main facts in regard to the mode of occurrence of apatite deposits in the Laurentian rocks of Canada were explained, and the great economic importance of such accumulations was considered. —— Mr. Fraser Torrance who, as a mining-engineer, has had large experience with the deposits found in the vicinity of Ottawa, gave a very interesting description of the character of some of the deposits, and of the difficulties met with in working them, owing to the irregular manner of the deposition of the mineral; which cannot be considered as occurring either in veins or in beds, but as passing from one to the other without any regularity of transition. The methods in which the present surface-workings are conducted are such as to throw most serious difficulties in the way of any future mining of the lower deposits. The imperfect manner in which apatite has hitherto been manufactured in Canada was described; and it was stated that it was highly probable that much of the mineral which was mined in Canada and exported to Great Britain returned, either in the raw or manufactured condition, to the United States. —— Mr. F. D. Adams reported the detection by him, in minerals received from Arnprior, of a specimen of rock identical with that in which apatite occurs in Norway, and which had previously been known only from Norway and Finland.

Boston society of natural history.

March 5. — Prof. A. Hyatt read a paper on the larval theory of the origin of cellular tissue. He reviewed the history of investigation among sponges; concluding, that, though true metazoa, they possessed characteristics which showed them to be derived from protozoa. The parallel between the development of the cell and egg in the tissue is strictly parallel with the evolution of nucleated from unnucleated forms in protozoa. Recent investigations have removed all objections to the homology of the egg or any cell with the adult of the nucleated protozoon; and the principal mode of reproduction by division is the same in all these forms. The egg builds up tissue by division after being fertilized by the male or spermatozoon, just as the protozoon builds up colonies after fertilization. Spontaneous division of a cell which undergoes encystment takes place, and the spermatozoa which result from this are true larval monads. These resemble the monads derived from division of the encysted bodies of protozoa in their forms and in their activity. They differ in being able to fertilize the female or ovum at once, instead of being obliged to grow up to maturity before arriving at this stage. Thus all cells may be regarded as larval protozoa, and eggs and spermatocysts as encysted larval forms, the spermatozoa being equivalent also to larval forms which have inherited the tendencies of the mature forms in the protozoa at the earliest stages. Thus the origin of the tissues in the metazoa is in exact accord with the law of concentration and acceleration in heredity. The cells are larval, which, in accordance with this law, have inherited the characteristics and tendencies of their adult ancestors in their earliest stages. The three layers can be accounted for as larval characteristics inherited from colonies of Infusoria flagellata, which had two forms (protective and feeding zoons), and then three (protective, feeding, and supporting), these corresponding to ectoderm, endoderm, and mesoderm. —— Dr. M. E. Wadsworth read a paper on the structure of the earth's interior, which he held to be a molten or semi-fluid mass, which will gradually cool and solidify.

NOTES AND NEWS.

THE National academy of sciences will hold its next annual session at the National museum, Washington, commencing April 15, at eleven A.M. An election of five new members will be held. This will not make good the vacancies of the past year; for, of the ninety-eight members on the roll a year ago, six have since died, — Professors Alexander and Guyot

of Princeton, Gens. Humphreys and Warren of the Corps of engineers, Dr. LeConte of Philadelphia, and Professor Lawrence Smith of Louisville. Dr. Engelmann, whose death we recently announced, was an honorary member, and, like all the others excepting Gen. Warren and Professor Smith, a foundation member. Only eighteen of the fifty foundation members of 1863 now remain. We shall soon print memoirs and portraits of Dr. Engelmann and Gen. Humphreys.

— Another effect of the great eruption of Mount Krakatoa has been recently noticed. It was followed by a series of barometric waves which seem to have spread almost over the entire world. Professor Förster of Berlin says, The great eruption in the Straits of Sunda, which happened on the morning of Aug. 27, gave rise to an atmospheric wave which showed itself for five or six days in the records of the self-registering barometers in all parts of the world. In the barometric markings which are registered by the Commission of weights and measures in Berlin, in order to have a permanent record of the minuter variations, these effects of the volcanic eruption appear with striking clearness.

The first atmospheric wave from this source appeared in Berlin about ten hours after the catastrophe. Supposing it to have taken the shortest course from its origin to Berlin, this time would indicate a speed of somewhat more than a thousand kilometres per hour, agreeing very closely with the velocity of sound. This result is in complete accord with barometric records in other parts of the world. About sixteen hours afterward a second and entirely similar barometric wave appeared, which, however, is to be considered as the arrival of the same wave by the longer circuit over America and Europe. In fact, if we take the difference of the two courses, — the one from the Straits of Sunda to Berlin over the East Indies, and the other over America, — we shall find that to the above velocity of propagation corresponds the delay of sixteen hours in the arrival of the wave by the American route. It thus appears that the entire wave completed the circuit of the earth in a time which must have amounted to thirty-six hours. In fact, thirty-six hours later there did appear in Berlin, in a direction from the East Indies, another perceptible wave corresponding closely to the first one, but somewhat diminished in strength. The corresponding return from America took place in a period of some thirty-four or thirty-five hours. This is brought into agreement with the other period by the consideration that the atmosphere in general has a motion from west to east. A third wave was recognized after an interval of thirty-seven hours from this time. The diminishing strength of the waves prevented the returns of the single waves from being accurately followed, but small variations of an unusual kind are seen in the record until the 4th of September. We can therefore be satisfied that the atmospheric waves caused by the volcanic eruption were powerful enough to make the entire circuit of the earth three or four times, and that in the beginning the variations of pressure amounted to one five-hundredth of the entire atmospheric pressure. We are thus obliged to recognize the operation of force through which the heated gases and masses of volcanic dust might be carried into very high regions of the atmosphere.

Mr. Baillaud of Toulouse has communicated to the French Academy of science similar observations of the phenomena, from which he concludes the velocity to have been 349 metres per second. This, also, is very nearly the velocity of sound. From the intervals between the waves, he finds that the waves made the circuit of the earth at the average rate of 324 metres per second.

The most important conclusion to be drawn from these extraordinary observations is, that a mass of air or gas of which no one had before formed a conception must have been ejected by the volcano.

— The entomologists of Washington and Baltimore have decided to form an entomological society. A preliminary meeting was held at the house of Dr. C. V. Riley on the evening of Feb. 29, at which Rev. J. G. Morris of Baltimore presided, and Mr. B. P. Mann acted as secretary. A committee was appointed to draw up the necessary regulations, and to call a future meeting for organization.

— A vineyard proprietor near Nimes, having had several complaints made to him about his wines, requested M. Barthélemy, of the Faculty of sciences at Toulouse, to analyze them for him. In some of them a rather large proportion of arsenic was found, larger than the trace sometimes found in red wines. The wine from one barrel tested contained no arsenic at all, and in this instance the cask containing the wine was a new one: it had not been previously used. The other barrels had been cleaned, after use, with 'drogue,' which, in point of fact, is diluted sulphuric acid; and the sulphuric acid of the central districts of France has of late years contained so much arsenic, that M. Barthélemy has sometimes used it to obtain a supply of that material.

— Mr. Winter Blyth has recently been employed to analyze imported canned fruits (apricots, tomatoes, etc.) in order to ascertain the amount of contamination by metal in them. In twenty-three samples the amounts found, calculated as stannous hydrate, ranged from 1.9 grains to 14.3 grains per pound, the mean amount being 5.2 grains. The juice and fruit in some instances had a metallic taste. Several of the tins showed signs of corrosion. The *Journal of the Society of arts* says, "The little that is known of the action of stannous hydrate may be summed up in a few lines. Doses of about .174 gram per kilogram of body-weight cause, in guinea-pigs, death with signs of intestinal irritation; but with doses smaller than .17 to .2 gram the effects are uncertain, and the animals generally recover. Hence, supposing a man to be affected in the same proportion, he would have to take from three to four drams, or consume at a meal ten pounds of the most contaminate of Mr. Winter Blyth's tinned fruits. But it is not a question of immediate deadliness: it is rather one for inquiry as to the action of small repeated doses continued for a long time.

— As long ago as 1868, René de Semallé made the statement before the Paris geographical society, that, granting the general diminution of the Indians of the United States from year to year, the decrease has been arrested in the case of the Iroquois and other partially civilized tribes; and that there will arrive a time when the general decline will reach its lowest point, and will be followed by an increase, normal and continuous. The total disappearance of a tribe is something very rare. At Nablous we find the Samaritans still protesting toward the temple of Jerusalem, destroyed eighteen hundred years ago. In the struggle for existence, before re-adjustments are made, the weak begin to decline before the strong; but, after the bloody struggle is over, each party to the conflict finds itself undergoing modifications which are the conditions of survival. In using the figures of the census reports and of the Indian-office report, M. Semallé falls into the error, pointed out by Mr. Simonin, of supposing that the Indians have increased by birth simply because there seems to be the addition of several thousands in the census. The truth is, there are many causes of fluctuation; such as crossing the border, and moving from place to place. The truth remains, however, that the Indians are slowly increasing.

— Dr. Delaunay is the author of a paper in the memoirs of the Société d'ethnographie, upon the inferiority of precocious races. The term 'precocity,' as applied by biologists to individuals, explains a similar phenomenon as applied to societies. Claude Bernard tells us that the force of development is greatest in the inferior animals, and that this precocity is an evidence of inferiority, and excludes longevity. The inferior races of men mature most rapidly. An Eskimo, African, Arab, or Cochin-China child of one year is farther advanced in body and mind than a white child of the same age. The young Japanese at Paris excel the French boys up to the sixteenth year; and then there is an arrest of development. M. Delaunay makes the same assertion respecting puberty, cranial sutures, the different centuries of history, sex, the various periods of the same life, strength of constitutions, and different parts of the same body. The inferior races, by virtue of their precocity, became civilized before the superior races, and then suffered an arrest of development, became extinct or fossilized. The races and the civilizations of China, Egypt, etc., have evolved just as the individual Chinaman or Egyptian has evolved. On the contrary, the higher modern societies have developed slowly, just as develop the men who compose them. We may go farther, says M. Delaunay, and affirm, that, as the members of the body develop with different degrees of rapidity, so do the various groups or classes of the same society. The author combats the idea that our modern civilizations are the children and heirs of the older ones, from which they sprang, and without which they would not now exist. Speaking of the French, he affirms that they did not descend from the Aryans; that their language is not Aryan; that their domestic animals did not come from Asia; that their civilization is Celtic, not Greek and Roman. Finally, the civilization of Europe has been retarded by influences from Asia. Not to speak of cholera, plague, and other maladies, two-thirds of our intellectual lives are spent in perpetuating the errors and exploded fancies of Asiatic, Greek, and Roman thinkers and myth-makers.

— François Lenormant, who recently died at the early age of forty-six, was a most enthusiastic student of antiquity. A man endowed with great power of work, and interested in all archeological research, he was in recent years more specially concerned with the early Asiatic civilizations. The study of the cuneiform inscriptions had for him special charms. The most interesting use which he has made of these researches is to be found in his book, *Les origines de l'histoire*. Here he finds in the literature of the cuneiform inscriptions abundant material for comparison with the early traditions of the Jews and of other nations, as to creation, the deluge, and a whole circle of primitive beliefs. One of the latest fruits of his pen is a translation of the book of Genesis, in which, by the use of different kinds of type, he distinguishes the portions which he supposes to have come from different authors. Though a good Catholic, M. Lenormant did not allow his religion to interfere with his science, nor his science with his religion. Himself a religious spirit, he claimed for investigation the fullest freedom, and denied the propriety of dividing science into a Christian and a non-Christian faction.

— Mr. T. Lewis writes as follows in *At home*: —

There is, as may naturally be supposed, no important break in the chain of mounds stretching along the Mississippi valley from its lower regions to Minnesota; for they are very numerous along the river-bluffs up to the mouth of the St. Croix. They are then met with at intervals on the plateaus and headlands of the Mississippi as far north as Little Falls. In like manner they occupy the River St. Croix from its mouth to Yellow River, if not beyond that point. They are also found in abundance on the lower Minnesota River, and continue up that stream to Big Stone Lake, thence along that lake and Lake Traverse, and down the valley of the Red River to beyond Winnipeg in Manitoba. About the geographical centre of Minnesota, and in the westward region adjacent, aboriginal earthworks are often discovered; there being some particularly noticeable ones in Otter Tail county. In the north-eastern quarter of the state, with one or two slight exceptions, we have no authentic account of the existence of any artificial mounds. There are also many mounds around Lake Minnetonka and along Crow River: indeed, there are more or less on nearly every small stream and lake in central and southern Minnesota. The largest one known in the state is situated on the lower end of Dayton's Bluff in St. Paul, its former height being eighteen feet. Another very handsome mound is located in the village of White Bear, near the lake shore: it is conical in form, and thirteen feet high. Occasionally elongated mounds and embankments have been met with that have been termed 'forts;' but definite surveys and much critical examination are required before it

will be safe to adopt the term as expressive of their true character and use.

This indicates how poorly represented is the state of Minnesota in mounds of any kind. The variety and contents give as little satisfaction as the distribution. Mr. Lewis well says, that the "task of thoroughly examining artificial earthworks by excavation is so onerous, and the prospect of finding any thing of material value to pay for it so slight, there being scarcely any thing but the knowledge acquired to compensate the labor, that few persons care to undertake such work for so poor a return."

— The Dorpat Naturforscher-gesellschaft has received by bequest A. Schrenk's collection of Mollusca, which has been named by Mr. S. Clessin, and arranged by Dr. Max Braun. A hundred and eight species of land and fresh-water shells are known to occur in the Baltic provinces, and of these the Dorpat collection now contains eighty-eight.

— Dr. M. Braun has continued his faunal exploration of the Finland Bay, and in connection therewith has studied the physical characteristics of the water. The temperature diminishes, and the amount of salt increases, with the depth; but the water is so shallow that in severe storms the whole is stirred, mixing the colder and salter water of the bottom with the top layers. The water thus varies greatly, and this fact must have a great influence upon the life in the bay. The observations are being continued by Commander H. von Roth, and, when completed, are to be carefully worked up.

— Zoölogists and microscopists will welcome the two instalments, just appeared, of Bütschli's learned and thorough treatise on the Protozoa, which is to form vol. i. of the new revision of Bronn's classical 'Thierreich.' Parts xx.–xxv., just received, are entirely devoted to the Flagellata. This work is important not only from its intrinsic value, but also because it is the first comprehensive scientific work on the Protozoa ever published, and must, as such, be very efficient in spreading fuller and more correct knowledge concerning this much misunderstood group of animals. The utter lack of conciseness is the worst, and, at the same time, a serious and inexcusable, defect of this invaluable volume.

— In the *American journal of science and arts*, vol. xxiii., 2d series, p. 276, a letter from Rev. George Jones, U.S.N., to Professor Silliman, written at Quito, Ecuador, Dec. 13, 1856, describes a fall of ashes from Cotopaxi, which was thirty miles distant, in which a purple sky was noted. The paragraph in which the mention is made runs as follows: "Yesterday morning we noticed that at the south the sky had an unusual appearance, being of a purple color for about 90° along the horizon, and so up to about 45° in height, the edge of this being mixed up with patches of white. About 12 o'clock ashes began to fall, first in small quantities; but by 8 o'clock the fall had got to be so considerable as to powder the clothes quickly, on our going out: and people coming into a house would look as we do at home when coming in from a snow-storm."

— The Amherst college scientific association, organized in 1883, has for an object the promotion of scientific knowledge among its members. It consists of the heads of the scientific departments of the faculty as honorary members, and of active members chosen by the association, at the close of the year, from the members of the junior class recommended by the faculty. At present the membership is limited to twelve. Meetings are held weekly, and consist either of an address by some member of the faculty upon scientific subjects, or a paper read by one of the members, followed by questions and discussions. During the present year the society has listened to President Seelye, on science; Dr. Hitchcock, on social science; Professors Todd, on mountain observatories; Emerson, on the state of geology one hundred years ago; Tyler, on the biblical idea of nature; and Pond, on student-life in Germany. Some of the papers read thus far, by members of the association, are on the relation of chemistry to civilization, the Iatro age of chemistry, eggs, alchemy, the phlogistic theory, the condensation of gases, state of ornithology a hundred years ago, the nebular hypothesis, and proofs of the antiquity of man in the eastern United States.

— M. J. Deniker has prepared for the *Revue d'ethnographie* a sketch of the Ghiliaks, who live about the mouth of the Amoor River, based chiefly on the elaborate works of Schrenk and Seeland, published in St. Petersburg, the former in 1881, the latter in 1882. The Ghiliaks are mentioned for the first time by Witsen (1707); but they have been visited by Russian travellers since, although several distinguished ethnographers have confounded them with the Ainos, Tunguses, etc. The word 'Ghiliak' is a Russian corruption of the Tunguse word 'Kilé.' The people call themselves Niback. Their country is quite restricted. Their villages are sparsely scattered along the valley of the lower Amoor to the Okhotsk Sea. The Oltchas, a Tunguse tribe, adjoin them on the south: the Samagheres, of the same stock, are on the west. Besides the valley and the mouth of the Amoor, the Ghiliaks people the neighboring shore of the Okhotsk Sea. Beyond the Tatar Straits, they are found all along the northern part of Saghalin, the southern part being peopled by the Ainos. According to Schrenk, they form, together with Yukagirs, Ainos, Kamtchadals, Koriaks, Chukchis, and Eskimo (extant), and Ostyaks (disappearing), and Omoks, Anaules, Kottes, etc. (disappeared), the family of Palaeasiatics, who have been pushed back by the later invading Mongoloids. The average height is 1.62 m. for males, 1.50 m. for females. They are dolichocephalic (76.5). M. Deniker gives detailed descriptions of their measurements, physiognomy, maladies, and character; their food, meals, habitations, housekeeping, clothing, occupations (both of men and women), arms, and transportation; their marriages, polygamy, cremation, religion, myths, and language. A singular custom exists of betrothing children at five or six years of age, in which case the father of the husband adopts the girl, and keeps her until the marriage takes place. After the death of a husband, the wife marries the husband's brother, although she

may decline if she please. The Ghiliaks burn their dead; while the Oltchas and Orotches suspend theirs from the trees, or bury them. Their superstitions and religious practices are very interesting, especially the *fête* of the bear, which takes place in January, and lasts fifteen days.

— Mr. J. G. Vassar has given an additional ten thousand dollars to Vassar college for the better support of the chemical and physical departments of the Vassar brothers' laboratory.

— A prize of five thousand pounds was offered by the Indian government for the best machine for the treatment of rhea fibre. In 1869 a Mr. Greig of Edinburgh made a machine for this purpose; but it did not fulfil the conditions laid down, so the full prize was not awarded. Another competition took place, but was unsuccessful. Some rhea fibre experimented on in 1852 by Dr. Forbes Royle was in strength, as compared with St. Petersburg hemp, in the ratio of 280 to 160, while the wild rhea from Assam was as high as 343. Rhea has the widest range of possible applications of any fibre, as shown by an exhaustive report on the preparation and use of rhea fibre by Dr. Forbes Watson. Last year, however, says the *Engineer*, witnessed the solution of the question of decortication in the green state in a satisfactory manner by Mr. A. Favier's process. This process consists in subjecting the plant to the action of steam for a period varying from ten to twenty-five minutes, according to the length of time the plant had been cut. After steaming, the fibre and its adjuncts were easily stripped from the wood. Mr. Favier's process greatly simplified the commercial production of the fibre up to a certain point; but it still stopped short of what was required, in that it delivered the fibre in ribands, with its cementitious matter and outer skin attached. Various methods of removing this were tried without success, until a year ago the whole case was submitted to the distinguished French chemist, Professor Frémy, member of the Institute of France. Professor Frémy carefully investigated the nature of the various substances, and found that the vasculose and pectose were soluble in an alkali under certain conditions, and that the cellulose was insoluble. He therefore dissolves out the cutose, vasculose, and pectose by a very simple process, obtaining the fibre clean, and free from all extraneous adherent matter, ready for the spinner.

— An account and hysometric chart are published by Alfred Grandidier of the district of Madagascar, occupied by the so-called Hovas, whose stout resistance to the French has recently attracted much attention. The country is very different from one's preconceived ideas of a tropical island. The word 'Hova,' it seems, refers only to the middle class of the nation, properly called 'Antai-merina,' or 'Merinas,' in contradistinction to the other two classes of nobles and slaves. The superior intelligence and discipline of the Merina race have enabled them to conquer, during the present century, most of the tribes which inhabit that immense island. The district which they specially inhabit is called 'Imerina.' It is a mountainous country, completely destitute of trees and shrubs, and often uncultivated. The higher parts are hardly inhabited, but the valleys and lowlands sustain a dense population. The hills, which are composed of masses of granite and dense red clay, are not fertile; but the smallest valleys, when their situation permits, are transformed into rice-fields by the intelligent and industrious natives. West of the capital, there is a large plain twenty miles square, once a lake or marsh, but now one huge rice-field, which presents a beautiful appearance in the wet season, with little hamlets or large houses rising out of it here and there like islands. Other vegetables and fruits of a sub-tropical character are cultivated with moderate success on the hillsides. In the southern part is an assemblage of peaks reaching to eight or nine thousand feet above the sea. From the highest of these the entire district is visible, and appears like a sea of barren mountains destitute of shrubs or trees, and with numerous detached rocks amid coarse grasses not suitable for cattle, and only useful for fuel. Only the rich can afford to send for fagots to a limited strip of woodland which borders the district on the east. Even the dry grass used by the people for cooking becomes very dear in the rainy season; a single fire, perhaps, costing twelve cents. The population of the district reaches a million, and of Antananarivo, the capital, one hundred thousand. The villages are usually built on the summits of hills, and surrounded by a ditch. They contain for the most part but a few dwellings of inexpensive character, and are near the cultivated rice-lands of their owners, which are very valuable, in some places worth eight thousand dollars an acre. The houses are of an oriental character, commonly with one door and one window opening westward to avoid the raw south-east winds. The houses are arranged quite irregularly, and generally are not very clean. The roads are mere footpaths, and, notwithstanding the multiplicity of water-courses, bridges are very rare.

The people are somewhat smaller than those of other Malagasy tribes, but full of energy and intelligence, and in spite of faults peculiar to barbarism, from which they are only just emerging, exhibit industry, economy, and relative sobriety. In these qualities the other tribes cannot be compared with them. They have large families, though the Merina women are said to become sterile if they leave the mountains for the coast. Manufactures have made but little progress, and are chiefly due to white instruction. The rainy season commences toward the end of November, and lasts until March; but there are few severe storms, except during the period from Dec. 15 to Feb. 25.

— In a paper in the Bulletin of the Moscow society of naturalists upon periodic oceanic oscillations, Trautschold attacks the problem of oceanic alterations of level, and their relations to geological phenomena. His conclusions, based upon a careful study of the past and present physiography of eastern and central Europe and western Asia, are to the effect that many of the phenomena of sedimentation and

deposition attributed by geologists to a subsidence of the crust, are, in fact, due to periodic oscillations, or upheavals of the oceanic surface, producing thereby inundations of the land-masses; and that such is the nature of much of the newer sedimentations, e.g., Jurassic of Russia. The position here maintained, a revival of the views of many of the older geologists, is anticipated by Professor Edouard Suess, who, in his 'Antlitz der erde' (Prague, 1883), clearly indicates the necessity of invoking the assistance of periodic oceanic fluctuations of level to account for the existence of much that has been heretofore attributed to terrestrial subsidence.

— The seventh Saturday lecture in the National museum was on Feb. 16, by Prof. E. D. Cope, on the 'Origin of human physiognomy and character,' — a discourse the main features of which have already been published in the *American naturalist.* On Feb. 23, Mr. John Murdock, late of the signal-service party at the Oglaamie station, North Alaska, gave a very vivid account of 'Eskimo life at Point Barrow.'

— Mr. E. R. Quick has presented to the Brookville (Ind.) society of natural history his entire collection of birds, numbering several hundred specimens, mostly North American. This is one of the largest and best-arranged collections in the state. The society is this year providing a course of free lectures upon popular scientific subjects for the benefit of the citizens of its town. Five of the lectures have been given, and three more are to follow at intervals of three weeks. The last was given by Prof. Jos. F. James of Cincinnati, upon 'Flowers and insects.'

— The museum of comparative zoölogy has published another of its useful 'selections from embryological monographs,' intended to bring together illustrations from the most authentic sources of the early stages of development of various groups of animals. This one is concerned with the Echinodermata, and is compiled by Mr. Alexander Agassiz. It consists of fifteen excellently executed quarto plates, crowded with figures, and accompanied by very simple explanatory text, the bibliography of the subject having already appeared in an octavo form. The protozoa, acalephs, polyps, fishes, and reptiles are announced as in course of preparation.

— All students interested in the study of the brachiopods will be pleased to learn that the last parts of the series of superb monographs of Thomas Davidson, on British fossil Brachiopoda, are completed by the author, and are now in the printer's hands. In a letter received by a correspondent a few days since, from Mr. Davidson, he says that "after thirty-three years of hard labor, in connection with British recent and fossil species, I this year complete my large work; and, indeed, the whole remaining manuscript is in the printer's hands, and being printed. This last part includes, 1, an appendix to the supplements, with plates; 2, an elaborate general summary, with numerous illustrations of the progress of science in connection with the Brachiopoda from 1606 up to the end of 1883; 3, a catalogue of all the British species of the class, some eight hundred and sixty in number, with geologic distribution in time, and full references; 4, a brachiopod bibliography, which I have been compiling during the last forty years. I have some four thousand entries; and it will, I feel sure, prove to be very useful for references. I began it at 1606, and continued it up to the end of 1883." Of the value and character of this great work, this is not the place to speak; but we cannot refrain from expressing feelings of gratitude, respect, and honor to the man who has given his time and means to prepare for publication a work that reflects so much credit on modern science, especially the division of invertebrate paleontology. Mr. Davidson is now in the sixty-seventh year of his age; and we trust that many useful years still remain to him, in which he may contribute information from his studies upon the Brachiopoda of other countries than Great Britain.

— According to the San Diego papers, a large stone lance-head of Eskimo fashion was found deeply embedded in the tissues of a whale taken at the whaling-station on Ballast Point, near the harbor. The species is not named, but the creature was probably Megaptera versabilis. The migrations of the California gray whale, Rhachianectes glaucus, are well known, though it is not hunted by the Eskimo; but those of the other species have been less clearly made out, and facts of this sort are worth putting on record.

— Charles Ashford continues his investigations of the Spicula amoris in British Helicidae. He examined Zonites excavatus and Z. nitidus. Until recently the latter was supposed to be the sole member of its genus which possessed a dart: now the former keeps it company. The arrangement of the secreting-organs is remarkably like that of Zonitès intertextus and suppressus, as figured by Leidy. The dart is found in a very small percentage of the total number of adults examined. On the other hand, in Helix virgata ninety-five per cent of the adults examined have furnished darts.

— Dr. Benjamin Sharp, the professor of invertebrate zoölogy in the Academy of natural sciences of Philadelphia, will be inaugurated on Tuesday evening, March 18, on which occasion he will deliver a lecture on 'Methods of biological investigation in Europe.' Professor Sharp's course on biology will begin on Thursday, March 20, at 4.15 P.M.

— Dr. D. G. Brinton, the newly elected professor of ethnology and archeology, will deliver a course of lectures in April, introductory to an extended and thorough course to begin next autumn. The subjects of the spring series are as follows: 'Prehistoric man in the new world,' 'Origin of the Aryan races,' 'The study of ethnology in the United States,' and 'The civilized races of America.'

— Two of the naval ensigns pursuing a scientific course at the National museum, Mr. Harlow and Mr. Dresel, have been ordered to the Greely relief expedition.

SCIENCE.

FRIDAY, MARCH 21, 1884.

COMMENT AND CRITICISM.

THE work of the census has again, and for the third time, come to a stop for lack of money. This time the suspension is more serious than ever, the working-force being reduced to the chief clerk, who is also acting superintendent, and an assistant. The public printer has been notified to stop printing the reports; and, unless some extraordinary step is taken, the whole work of the bureau for four months to come will be confined to opening the daily mail. Several volumes of the final report have been published, and have been received with unqualified satisfaction, both here and in Europe; demonstrating, as they do, that this census is the most complete and the best organized ever yet attempted by any nation. The remaining fifteen or twenty volumes are understood to be ready for printing. The causes of delay are two, — the modesty of the superintendent in his requests to Congress for money, and the overcrowded state of the government printing-office. Surely Congress will not refuse to make apropriations of the most liberal dimensions to carry on this work, and to secure the printing of the reports before they have lost part of their interest through age. Let the demand be for a quarter of a million, if necessary; and let the office staff be increased in efficiency by the appointment of a special staff of experienced editors, who shall aid the superintendent in bringing the publication to an early termination.

THE fourth number, for March, of the pilot chart of the North Atlantic Ocean, issued by the Hydrographic office, differs from the earlier sheets of the series, notably in the number of icebergs reported for February south-east of Newfoundland. An aberrant berg appears about three hundred miles west-south-west of Ireland, in latitude 51°, longitude 18° west. In the legend concerning the weather reported for February, we are glad to see the term 'straight-line gale' of the previous charts reduced to the more non-committal 'gale;' but the absence of 'cyclones' is still insisted upon. Whatever be the meaning attached to this word by mariners, its ordinary use to include all large rotary storms, whether from within the tropics or not, is now so general and so proper, that the repeated statement, 'no cyclones are reported' for the winter months of the stormy North Atlantic, surely needs qualification. The intention is, no doubt, to state that no *tropical* cyclones have come up along our coast from the West Indies: if so, it should be more explicitly worded.

The compilation of observations on wrecks and abandoned vessels promises valuable results for the determination of currents. In only four months' records, over sixty examples are given, in many cases identified by name, and in a few cases reported by two or more observers on different dates. When the wrecks are floating almost awash, presenting little surface for the wind to blow upon, they will move only with the surface-drift, and, as noted in sucessive positions, will give excellent data for measuring the direction and velocity of currents. By thus keeping track of their movements, it will be possible to avoid the error of the old-fashioned bottle-experiments, in which only the beginning and end of the course were determinable, and time of passage was unknown. At the end of the year we shall hope to present a *résumé* of the results thus attained.

THE various local sub-committees of the British association at Montreal seem to be pushing the work in their special subjects with an energy which promises much for a successful meeting in August. In the section of economics especially, the committee is taking advantage of the opportunity presented, by bringing

forward papers which will give a comprehensive survey of the various important economical questions which are just now exciting so much discussion with reference to the future growth and prosperity of the colony. Among these, agriculture necessarily occupies a prominent position; but it is gratifying to see that general and technical education is also to receive important consideration.

Our leading article mentions at its close the brief life and sudden death of a society formed for home study for young men, modelled upon the older society, still vigorously flourishing, restricted to young women. Why there need be distinct organizations of that sort for the two sexes, it is a little difficult to see; but it is a little curious to find, that, hard upon the death of the 'Young men's society for home study,' a new organization has sprung up for the same purpose, but without limitation as to sex, bearing the somewhat pompous title of the 'Correspondence university.' It announces forty-one instructors (two of whom are women), resident in eight states of the Union, besides one each in Germany and Scotland. Sixteen of these are assigned to different departments of science, eleven to mathematics, and six to modern languages; so that the scientific leaning of our new 'university' is very marked. We shall look with much interest at the result of this experiment; for the promoters of the enterprise have certainly secured the services of many most excellent teachers, and they aim at a higher grade of instruction than has been attempted by the earlier organizations. A large proportion of the teachers are connected with Cornell university, which may be considered the headquarters. Unfortunately, as far as published, the plan appears to lack that unity and proper co-ordination which would at once command respect and confidence; and its higher grade of charges, though still very small, may prove an obstacle to its popularity.

We are glad to see a change in the wording of the 'indications' issued by the signal-service. Heretofore, variations of pressure have been indicated by 'rising' or 'falling barometer;' although change in the warmth of the air has always properly been mentioned as 'higher' or 'lower temperature,' and not 'thermometer.' Now the wording is made uniform, and observations of the barometer are recorded as implying 'increasing' or 'diminishing pressure.'

The late issue of *Copernicus* (a double number, 33–34) will be received with no little regret by many astronomers, as it contains the unwelcome announcement that this periodical will be discontinued after the publication of No. 36. We understand that this action on the part of the editors is due chiefly to the insufficient list of subscribers; and it is much to be regretted, as *Copernicus* is the only astronomical magazine, printed in quarto form, in which excellence of typography and general attractiveness in appearance seem to be thought desirable. Its style has been rather that of book than of magazine printing, and its papers on mathematical astronomy have had as fine a setting as the average article in the purely mathematical quartos.

The periodical began in January, 1881, under the editorship and management of Dr. Ralph Copeland, astronomer to the Earl of Crawford and Balcarres, and Dr. J. L. E. Dreyer, then of the Royal observatory, Dublin, and now director of the observatory at Armagh. The first six numbers were issued under the name *Urania*, for which *Copernicus* was then substituted, the editors having become aware of the previous existence of an astrological journal called *Urania*. Its many pages, devoted to the reviews of current astronomical literature, have formed a very valuable feature; and arrangements were, from the beginning, concluded with the Earl of Crawford and Balcarres whereby all the subscribers to this journal have received at the earliest moment the 'DunEcht circulars,' forwarded directly from Aberdeen. The new magazine has fairly established its claim to be 'an international journal of astronomy;' the chief astronomers abroad who have contributed to its support being the Earl

of Rosse, the Earl of Crawford and Balcarres, Drs. Wagner, Schjellerup, Ball, and Backlund, and Professors Klinkerfues and Bredicton. American astronomers have also done their full share; papers having been contributed by Dr. Peters, and Professors Pickering, Holden, Todd, Wright, and Stone. We express the hope that *Copernicus*, as a high-class journal for the publication of astronomical papers, may at some future time be re-issued under the same management as before.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

'Illusive memory.'

THE subject presented in *Science* for March 7 (p. 274) under the above heading, by Mr. Osborn, if an obscure, is certainly an interesting problem in psychology. Its scientific treatment, however, will probably require a much wider range of investigation than that proposed by the writer. He has indicated 'two widely different theories' in explanation of the mental phenomenon: a third hypothesis appears to have escaped him.

Plato, as is well known, recognized this peculiar condition of the mind, and made use of it as an evidence of pre-existence, — a fancy embodied in the familiar lines of the poet: —

> "Our birth is but a sleep and a forgetting:
> The soul that rises with us, our life's Star,
> Hath had elsewhere its setting,
> And cometh from afar:
> Not in entire forgetfulness,
> And not in utter nakedness,
> But trailing clouds of glory, do we come."

If, now, we substitute for Plato's conception of an individual personal experience the more prosaic one of ancestral experience, we shall have, in brief, the third hypothesis, — the partial continuity of consciousness through genetic descent, instead of through metempsychosis or transmigration. From this aspect, the problem of the irreferable impressions of vague reminiscence would not fall under the class of *erinnerungs-täuschung*, or '*illusive memory*,' at all.

The modern reference of all the varied 'instincts' of animal life to the simple physiological datum of the heredity of a limited experience and memory, would naturally lead us to anticipate some such exhibition in the human race; nay, rather to wonder why we do not find such experiences much more pronounced and abundant. Notwithstanding the enormously greater expansiveness of cerebral action in man than in his lower fellow-creatures, the long-continued or reiterated impressions of a far-reaching ancestry would seem to justify the induction that 'intuitions' (so precious to the metaphysician) should be manifested in particular channels in a much stronger and more decisive form than we actually observe. Here, then, is a negative psychologic problem calling for explanation, and well deserving a careful comparative investigation.

To satisfactorily test this 'third hypothesis' is undoubtedly an extremely difficult undertaking, both by reason of the usual 'haziness' of these Platonic reminiscences, and of the rare opportunities of authentic verification of special parental or aval recollections. The question, however, is one of such biologic importance, that it merits an even laborious research; and, if in only one or two instances a clear evidence of such transmitted memory in man could be established, it would justify the inference that many similar cases are referable to the same principle.

The inquiry should include the antecedent experiences of grand-parents as well as of parents: since there is reason to believe that aval heredity is *relatively* more frequent than direct parental heredity; or, in other words, that there is a tendency to 'alternate generation' running through the animal kingdom.

W. B. T.

Washington, March 13.

'The oldest living type of Vertebrata,' Chlamydoselachus.

In *Science*, No. 57, p. 275, my friend, Professor Cope, falls into the error of placing among the species of the genus Diplodus Ag. (re-named Didymodus by Cope) the 'peculiar selachian' recently discovered, and described by me in these columns. With the specimen before him, he would be the last man to make such a mistake. And no doubt he will thank you for giving the space necessary to a correction.

The most important of the characters on which the genus Diplodus was founded by Agassiz (1843, Poissons fossiles, iii., pp. 204, 209), that by which it is separated from Hybodus, Sphenonchus, and Cladodus, is a greater development of the secondary cones of the teeth, while the median cone remains rudimentary or comparatively undeveloped. This is not the case with Chlamydoselachus: it is not the secondary, but the median, cone in which is found the greatest development; agreeing in this respect with Agassiz' genera Hybodus, Sphenonchus, and Cladodus, in which "le cône médian l'emporte sensiblement sur les cônes latéraux, et se développe en quelque sorte à leur détriment." In the teeth of Chlamydoselachus, the cone at either side of the median is a mere rudiment. If the new selachian was to have been placed in either of the fossil genera mentioned, it should have been Cladodus. Mr. Cope says of Didymodus, 'The species possess two, three, or four denticles.' Of course, a second thought will increase the number so as to include Chlamydoselachus, which has more than four.

The propriety of placing living species in fossil genera of so long ago on account of resemblances in a single organ, such as a tooth only of a selachian, is to be questioned. The teeth do not give satisfactory clews to structure and shape of other organs, or of the body itself, in the majority of the sharks and skates. This is evident enough on comparison of the teeth of Carcharias, Alopias, Zygaena, Squatina, Torpedo, Scyllium, Raja, Triakis, Disceus, Mustelus, Trygon, Pristis, Potamotrygon, Rhinobatus, Dicerobatus, and others. It would be hardly worth the while to separate recent genera by the number and position of fins, or shape of body, and then make them equal to the same fossil genus on account of some similarity in teeth. Material in my possession will enable me, as soon as the necessary drawings can be made, to prove conclusively that Chlamydoselachus does not belong to the genus Didymodus of Cope (=Diplodus Ag.), and that it was hardly safe to announce Didymodus as the 'oldest living type of Vertebrata' until more was known about Chlamydoselachus.

S. GARMAN.

Cambridge, March 17.

The 'shark recently discovered in Japanese waters,' described by Mr. Garman as Chlamydoselachus anguineus (in *Science* for Feb. 1, vol. iii. pp. 116, 117; *Bull. Essex inst.*, vol. xvi.), as its describer has remarked, "is a form of more than ordinary interest on account of the respects in which it differs from the majority of its kindred." It not only appears as a new element in selachology, and becomes the representative of a hitherto unknown type, but it throws light on the ancestry and some of the extinct forms of the class; and, still further, it may serve as a guide for the interpretation of certain of the tales of the sea-serpent.

In respect to its place in the system, I perfectly agree with Mr. Garman, that it is the representative of a very distinct family (Chlamydoselachidae): I am also of the opinion that it may be regarded as the type of a distinct sub-order at least. Mr. Garman, in *Science*, was "inclined to consider this the type of a new *order*, to which the name Selachophichthyoidi might be given;" but in his article in the Essex bulletin he is entirely silent on the subject of the major relations of the new type. The name, having been thus never defined, and being objectionable on account of its length and cacophony, might be replaced by a shorter one, like Pternodonta; but on this I shall not insist. A more important question is, What is the status of the selachian in classification? Mr. Garman thinks that 'it stands nearer the true fishes than do the sharks proper.' I do not know how he would express this idea in a linear arrangement, but most would do so by placing it immediately between the selachians and fishes. I am also disposed to consider Chlamydoselachus to stand 'nearer the true fishes than do the sharks proper,' not because it appears to be in the line of descent *between* the two, but because it is nearer the primitive line from which both types have diverged. Judging from Mr. Garman's remarks in the two articles referred to, I presume there would be essential concordance between us as to this point.

As to the relations of Chlamydoselachus to extinct types, however, I must dissent from Mr. Garman. Fortunately, an article throwing light on the affinity of Cladodus has been published recently, — probably too recently to be available to Mr. Garman. I refer to Dr. R. H. Traquair's communication 'on a new fossil shark,' in the *Geological magazine* for January, 1884 (decade 3, vol. i. pp. 3-8, pl. 2). Dr. Traquair has therein made known the form of the cladodont selachians, and proved beyond doubt that the cladodont dentition and ctenacanthoid spines co-existed in the same fish. The 'new shark' in which these parts were coincident has been named Ctenacanthus costellatus. In the words of Dr. Traquair, "accepting the fish just described as a new species of Ctenacanthus, it yields us the following important facts regarding the genus: —

"1. The shape of the animal was moderately elongated, with blunt snout and heterocercal tail. 2. The skin was covered with shagreen granules, mostly of an ornate, ridged, pectinate character. 3. There were two dorsal fins, each with a spine, that of the first being the longer. There were no paired spines, and the ventral fin was opposite the second dorsal. The presence of an anal fin is doubtful. 4. The dentition was cladodont. 5. The vertebral axis was unsegmented, but there were extensive calcifications in connection with other parts of the skeleton."

It is obvious from this summary, that Cladodus was not at all related to Chlamydoselachus; and I may add, that it did not have the essential dentition of Chlamydoselachus, so well indicated by Mr. Garman in the statement that "each tooth has three slender, curved, inward-directed cusps, and *a broad base . . . preventing reversion.*"

But, as Professor Cope has claimed (*Science*, vol. iii. p. 275), Chlamydoselachus did have a representative in the carboniferous genus Diplodus, or Didymodus; although I do not think that the two can be congeneric. In fine, the recent discoveries by Messrs. Garman and Traquair enable us to co-ordinate a number of extinct types, and compel us, I think, to add two sub-orders or orders to the list of those necessary for the long-known living forms. The living sharks I have proposed (in Jordan and Gilbert's Synopsis of the fishes of North America, p. 967) to distribute among four sub-orders; of which the Opistharthri or Notidanidae are the most generalized, and the Rhinae or Squatinidae the most specialized. The two additional sub-orders appear to be still more generalized than the Notidanidae, and the sequence would therefore be as follows: —

1. Lipospondyli, including selachians without developed vertebrae, but with a persistent notochord, and comprising the family Hybodontidae (Hybodus, Cladodus, Ctenacanthus, etc.).
2. Pternodonta or Selachophichthyoidi, including Squali with vertebral condition unknown, and with teeth having fixed bases, comprising the family Chlamydoselachidae (Chlamydoselachus and Didymodus).
3. Opistharthri or Cyclospondyli.
4. Proarthri (Heterodontidae).
5. Anarthri (most living sharks).
6. Rhinae.

It is by no means certain that the hybodontids are Squali at all, and they may prove to be more nearly related to the Holocephali. The plate of Dr. Traquair's memoir delineates very plainly one external branchial aperture, and one only; and the condition of the vertebral column and dorsal spines are features in which there is greater resemblance to the Holocephali than to the Plagiostomes. The primitive form from which the two diverged must theoretically have been not unlike the new Ctenacanthus, and it is quite possible that in the hybodonts we may have one of the 'missing links' between the two groups.

I had intended to refer to certain of the 'sea-serpents' which might be correlated with Chlamydoselachus; such as the Maine animal noted recently in the *Proc. U. S. nat. mus.*, the animal seen by Capt. Hope about 1848, and the selachian found in 1808, and partially described by Dr. Barclay, but must defer a notice to a future time. THEO. GILL.

Evidence of unrecorded tornadoes.

There is evidence in the forests of Pennsylvania that many localities have been visited by tornadoes of which no accounts have ever been recorded. The places referred to are called 'windfalls;' the timber having been prostrated apparently by violent storms of wind, while the trees immediately adjoining remain erect and undisturbed. Sometimes, instead of forming a path through the forest, the tornado has descended, and quickly ascended into the air, leaving its marks on a small area. Judging by the remains of the timber-trees thrown down, these events were of all ages, and of various degrees of violence. Sometimes the fallen timber was found sufficiently sound, after the first settlement of the country, to be worth manufacturing into lumber; in other cases, being older or more shattered, it was worthless; while in others it has entirely decayed and disappeared, the ground being covered with a later growth of a smaller and different kind, and the sur-

face dotted with hillocks, like rifle-pits, caused by the up-turned roots of large trees, of which no other vestige remains. In the eastern part of Bradford county were extensive ancient windfalls, still recollected by the older inhabitants, where now is a fine, well-cultivated farming-country; and in the southwestern part of the same county a tornado of a later date left a long, straight path through the pine timber, which was known as the 'Devil's Lane.' I have seen the track of an extensive tornado in the forest of one of the Alleghany Mountain counties of this state. I have reports of others in West Virginia and in Indiana, and of very numerous ones in the vast forests of Lower Canada, in New Brunswick, and Nova Scotia. Every hunter and lumberman who has travelled through the forests is familiar with these evidences of more or less ancient tornadoes, and of a few in later times. From their occurring in uninhabited regions, and from their not being attended with loss of life or improvements, no accounts of them are to be found, and the traditions of them are soon forgotten. In the further study of this interesting subject, these fossilized tornadoes, so to speak, should not be overlooked. The tornadoes of Kansas, Missouri, Illinois, Minnesota, and Georgia, are probably only repetitions of what has at long intervals occurred fortuitously in all parts of our country.

James Macfarlane.

Towanda, Penn., March 11.

[Windfalls are the subject of Tornado circular No. 12, which may be obtained on application to the chief signal-officer, U. S. Army, Washington. Information concerning the location, direction, length and width, and, if possible, also the date, of these old tornado-tracks, is much desired.]

Remains of a prehistoric tree.

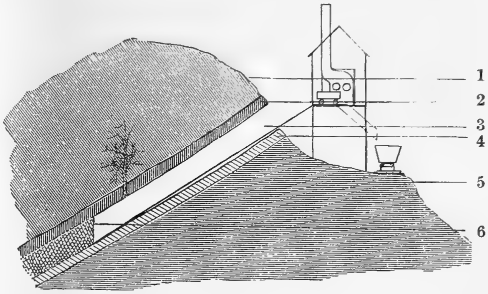
While making some assays for the Oregon iron and steel company, during the past summer, I was often in the mines of the company at Oswego, eight miles south from Portland, Ore.

Being on one occasion about five hundred feet down the main gangway, my attention was called to a curious 'hole in the roof.' On examination, I found it to be a perpendicular cylindrical cavity in the roof-rock, in diameter about ten inches. Upon feeling the walls of the cavity, I found the surface somewhat rough, like the bark of a tree. Introducing a lamp, I could discern small indentations corresponding to the knots and twigs upon the trunks of trees. I was convinced that the hole had once been occupied by a tree, and, procuring a jointed pole, probed the cavity to a height of twenty-two feet. Toward the top the indentations became more numerous; and, by replacing the stiff pole by a flexible bamboo, the side orifices could be probed to a depth of two or three feet, and seemed to have a slight inclination (see figure).

Examining the ore on roof and sides, I was rewarded by finding a network of roots, which retained their original forms perfectly, although petrified. I procured one specimen an inch and a half in diameter. An analysis of it showed the material occupying the position of the original bark to be kaoline; it being perfectly white, and about a quarter of an inch in thickness. Inside this ring of kaoline the wood had been replaced by iron ore, not differing from that of the surrounding vein.

Above and below the ore I found no roots; the tree having grown in the space now occupied by the ore-vein, and at an inclination to it. The strata dip to the north at an angle of 35° to the horizon.

Immediately under the ore is a stratum of scoriae one to three feet in thickness. Below this is hard, compact basalt. The roof of the mine is 'greenstone,' decomposed by heat to coarse sand-rock immediately over the ore. The ore-vein averages five feet and a half in thickness.



Section in mine at Oswego, Ore.

1, 'greenstone;' 2, sand-rock; 3, gangway; 4, scoriae; 5, basalt; 6, ore-vein.

At six hundred feet I found pieces of wood not petrified, and in a good state of preservation, some parts showing a charred surface. I found afterwards, in other parts of the mine, several smaller orifices in the roof-rock, and similar to that described above.

Harold B. Nye.

Congenital deafness in animals.

Mr. Lawson Tait, quoted by Professor Bell in *Science*, No. 54, says that 'congenital deafness is not known to occur in any animal but the cat.' In contradiction to this statement, Dr. Burnett has reported to you (No. 57) the cases of two deaf dogs; and I now refer you to the mention of *a deaf-mute cow* in Dr. Haubner's 'Bericht über veterinärwesen,' quoted in the 'Organ der taubstummen- und blinden-anstalten in Deutschland,' vol. xxv. p. 176. This cow was twelve years old, and had been in the possession of the same owner since she was three weeks old. She was perfectly deaf to all sounds. At feeding-time, or when a calf was taken away from her, she made the same demonstrations that other cows do, stretching out her head and neck, and opening her mouth wide as if to bellow, but only making a short, deep, gurgling sound, very different from the ordinary lowing of cattle. Her sight was good, and she was an intelligent animal. Nothing abnormal could be discovered in her ears or throat. Her color is not mentioned. She had had eight calves: but whether these inherited their parent's deafness is not known; for in this case the danger, if such a danger existed, of 'the formation of a deaf variety' of the bovine race was effectually prevented by the early butchering of the calves.

Edward Allen Fay.

National deaf-mute college, Washington, D.C., March 14.

Muraenopsis.

Is it not by mistake that you state, in the review of 'Yarrow's check-list' (*Science*, No. 56, p. 264), that the generic name 'Muraenopsis' must be suppressed because 'pre-occupied among the eels'? The name was first applied to eels by Kaup (1856, 'Catalogue of apodal fish,' p. 11), though credited by him to Le Sueur. The latter, however, did not use it. His name was 'Muraenophis' (1825, *Journ. Philad. acad.*, v. p. 107), or 'Muronaephis' (l.c., pl. iv.), or 'Muroenophis' (l.c., index). Kaup's error was copied by

Günther (1870, 'Catalogue of fishes,' viii. p. 68). It is probable that by one or the other of these authorities you have been misled. 'Muraenopsis' was given to the batrachian by Fitzinger (1843, 'Systema reptilium,' p. 34) as a substitute for Amphiuma Garden, 1821. Subsequent writers have limited the genus Muraenopsis to the species with three toes, retaining in Amphiuma that with two. Examination of a considerable number of specimens shows that about one of every five individuals of tridactyla, from the same locality, has less than the normal number of three toes to each foot. For this reason it seems as if the species is not sufficiently distinct from the two-toed, Amphiuma means, to be entitled to rank in a different genus. In this view the genus Muraenopsis should be suppressed, and the name placed as a synonyme for Amphiuma.

S. GARMAN.

Mus. comp. zoöl.

[The writer of the review above mentioned must confess to a blunder. Not having a copy of Le Sueur's paper at hand, he trusted to the quotations made by Kaup and Günther. The former writer, as above stated, expressly adopts the genus Muraenopsis from Le Sueur.]

STUDY AT HOME.

IN discussing the value of a new plan for making men wiser and better, the thing to do is not to compare it with other plans in successful operation, with which it does not propose to interfere, but simply with the state of things in which it is absent. No one pretends that personal instruction is not of value, or that the urgent stimulus and vivid directness of a living teacher and a *viva voce* explanation can ever be replaced by the slow medium of letters. When an organized effort was made to introduce home study on a large scale, it was on account of the patent fact that there are many young people, and many people no longer young, who are not in a condition to go to school, and to whom, nevertheless, the systematic study of some subject in which they take an interest would be a benefit and a delight. The difference between a sporadic effort to do a little solid reading by one's self, constantly interrupted by flagging interest and by difficulties too hard to overcome, and a regular correspondence with some one who is able and willing to lend encouragement and aid, is very great. If the enthusiasm for this sort of work should become so wide-spread as to keep large numbers of students from giving themselves a regular course of instruction in school and college, it would be time to consider the evils of the plan; but of this there is little danger at present.

Ten years ago some reports of an English organization, called the 'Society for the encouragement of home study,' fell into the hands of a group of missionaries in Boston; and they were immediately inspired with a desire to work out the idea suggested by the title. An exchange of letters with the English secretary was of very little assistance in the development of the American plan. The English society offered no correspondence, but simply sketched out courses of reading, and plans for botanical and art work, to be carried on without assistance for a year, after which the students were expected to go to London for a competitive examination with prizes. In the autumn of 1873, the 'Society to encourage studies at home' was established by a committee of ten persons, six of whom carried on the correspondence with the forty-five students who offered themselves for instruction in the course of the year. Only two points of method were settled at the beginning; namely, that there should be a regular correspondence, and that there should not be competitive examinations. Later the plan was developed of making the students take notes from memory, at the beginning of each day's work, of the reading of the day before, and send to the appointed teacher at the end of each month a few sample pages of their daily notes, and a full abstract, written from memory, of their month's work. There are also frequent examinations; and by this means the students are divided, at the end of the year, into a first, second, and third rank. The plan of giving certificates, based upon the results of an annual examination, was abandoned after two years' trial. The annual fee charged is merely a nominal one, — two dollars at first, and afterwards three, — but it has been sufficient from the beginning to cover all the expenses of paper, postage, the printing of the necessary circulars, the salaries of the assistants to the secretary and the librarian, and for the last two years the rent of the rooms on Park Street, Boston, where the society has its headquarters.

The work of the teachers is, of course, a labor of love. In numbers the society had a very rapid growth for the first four years of its existence, and since then it has remained nearly stationary. In 1880 over eleven hundred students entered, of whom seventy-one per cent persevered throughout the year, and twenty-six per cent were excused for sufficient reasons. The number of teachers is about two hundred. History, science, and art, French, German, and English literature, are the subjects taught; and the proportion of students in each subject remains almost constant year after year. More remarkable still, the subjects divide themselves into three groups of two subjects each, which keep nearly abreast

of each other. An average of the last four years shows, that, out of every hundred students who have persevered, thirty-four have taken English literature and thirty-three history, twelve have taken science and eleven art, five have taken German and four French. History is taught by topics, and there are circulars giving minute directions for critical study in the literatures of the different languages. The Shakspeare paper is particularly suggestive and valuable. Much thorough scientific work is done, if it is of an elementary character. Geology and mineralogy are taught by sending specimens and requiring observation and description, as in the class-room. Excellent work has been done in blowpipe analysis, and several students who live in fossiliferous regions have made discoveries in their own neighborhood. Botany has always been well taught: most of the teachers have been pupils of Gray, Goodale, and Farlow. Biological subjects have not been popular; possibly owing to the lingering survival of a lady-like repugnance to frogs, mussels, and moulds. Physics and chemistry have not been attempted. That the scientific department is thoroughly well conducted is assured by the fact that it is under the charge of the head of the woman's chemical laboratory of the Massachusetts institute of technology.

The society has a lending-library, which began with the purchase of twenty-nine books in 1874, and which has now about a thousand volumes, many of them valuable works in illustration of archeology and art. Out of the eight thousand issues which have been made to the most distant states and territories, through floods and railroad accidents, only twelve volumes have been lost in the mails, and five through the carelessness of students. A small pamphlet enforcing obedience to the rules of health has been prepared by the secretary, and is sent to every one who joins the society. The pupils are widely distributed, both socially and geographically. Massachusetts and New York have always furnished the largest number, but not so many as the remaining Middle States together. The extreme south and the remotest west, as well as the Canadian provinces, are well represented. Many industries and all grades of society, above absolute penury and ignorance, furnish students. There are girls in cities with large allowances, and married women far from any post-office, who do their own household work. A telegraph-operator, a compositor, a matron of a public institution, a railroad paymaster (acting also as treasurer, and going up and down her road in that capacity), a colored teacher at the south, another colored woman well married at the north, have taken advantage of the society's courses. Six deaf-mutes have been among the pupils; and one, after studying several years, has become an associate teacher, and takes charge of four of her companions in misfortune. Mothers study for the sake of teaching their children; and even grandmothers, not to be left too much alone, join the rest of the family group. In age, half the pupils are between twenty and thirty, and one-fourth between thirty and fifty. Many continue their studies for several years. Last year there were more old students than new. One has been eight years in the society, has taken a full course in many subjects, has read a small library of important works, and has taken, after the first two years, the first rank in every thing. "Now and then an enthusiastic student tells us that she hopes to continue with us all her life;" and one writes, "The very thought of leaving makes me homesick." Those who have only known the active life of cities can have no idea how great a boon to a country girl is a correspondence with an intelligent and sympathetic woman. The students' letters are full of appreciation and gratitude. One says, "I only regret that I did not know of the society at the beginning of its existence;" and another speaks of having derived "pleasure and incalculable benefit from the systematic course of study prescribed." After buying a science text-book, a student writes, "It has cost me my summer hat, but I do not regret it in the least;" and another, "I pin my lesson copied the night before, to the kitchen wall, and the drudgery of dish-washing is removed." With such eager material to work upon, it will be strange if the society does not find some mute, inglorious Herschel, or some village Somerville, upon whom it will act as an inspiration to great things. If Du Bois Reymond was able to become a great physiologist at a time when rubber tubing was not an article of commerce, a girl who has learned to use the blowpipe by teaching at a distance must blame herself, and not her circumstances, if she does not do good work as a mineralogist.

A society for home study for young men has had an existence for three years, and has come to an end. Longfellow, Howells, and Holmes, John Hay, Justin Winsor, and Charles Dudley Warner, are among the names on its committee, and the reports for the first two years were very enthusiastic. They state that the students are twice as many as in the young women's

society for the corresponding years, that the average time given to study is ten hours a week instead of eight, that there has been no difficulty in finding a large number of cultivated gentlemen who were willing to give their time and attention to the work, and that the wonderful success of the earlier society may be taken as an indication of what may be done for young men by the same means. The secretary says, "This year's work has convinced us that we have every promise of the society's becoming a successful and useful institution, and that it is meeting a great need in a practical way." A year later it is decided to give up the organization; and no more specific reason for this course is given than that the committee is satisfied, on the whole, that the good done is not enough to make worth while the labor required of officers and correspondents.

THE BIOLOGICAL LABORATORY OF THE JOHNS HOPKINS UNIVERSITY.

THE recently opened biological laboratory of the Johns Hopkins university is eighty-four by fifty-two feet in external measurement, and

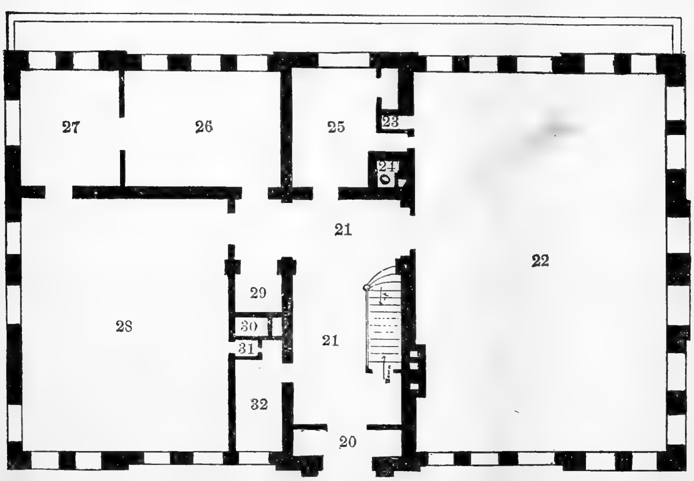


FIG. 1.—20, vestibule; 21, main hall; 22, work-room for practical instruction of less advanced students; 24, 30, ventilating-shafts; 25, storeroom of materials and reagents for general practical class-work; 26, chief assistant's room; 27, storeroom for diagrams and lecture-apparatus; 28, lecture-room; 29, elevator; 32, cloak-room.

consists of three stories and a basement. It is built of Baltimore pressed brick; with steps, entry, window-sills, and band-courses of Cheat-river bluestone. While free from any attempt at mere architectural display, the building is

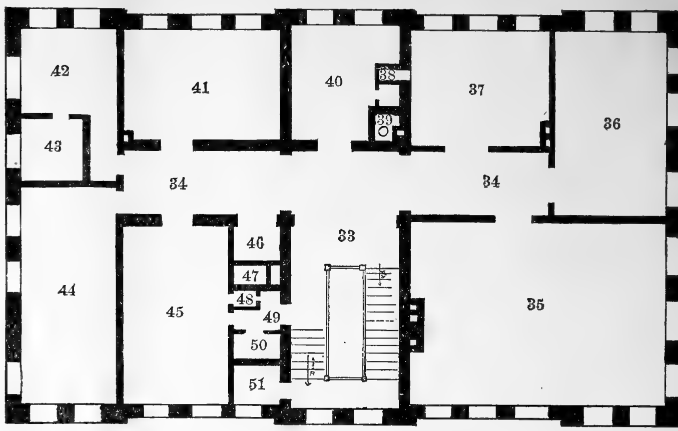


FIG. 2.—33, 34, hall and corridor; 35, museum; 36, advanced morphology; 37, preparation-room for museum; 40, assistant's room; 41, library; 42, 43, photography; 44, advanced botany; 45, lecture-room; 46, elevator; 47, 39, ventilating-shafts; 51, lavatory.

handsome, as will be seen on examination of fig. 5, which represents its north and west elevations. A fact that at once attracts attention is the number and large size of the windows: as the laboratory is free on all sides, it is therefore very well lighted.

On ascending the front steps, and passing through the door, the visitor enters the main hall, from which a wide staircase ascends to the third story, and on which most of the rooms of the first floor open. This floor is given up to the regular class-instruction of students not engaged in special work. It has on it (see plan, fig. 1) a lecture-room with seats for sixty; a storeroom connected with this, for the keeping of diagrams and lecture-apparatus; an administration-room, the headquarters of the chief assistant; a preparation-room containing a supply of the reagents, specimens for dissection, and histological material required for the daily practical class-work; and the large general laboratory, thirty-two by forty-eight feet.

The latter (fig. 6) has windows on three sides. Around these sides runs a work-table, supported, independently of the floor, on brackets attached to the walls, and affording ample space for thirty students. If necessary,

a second table can be set inside this, giving places for fifteen or twenty more. The centre of the room is in part occupied by a dissecting

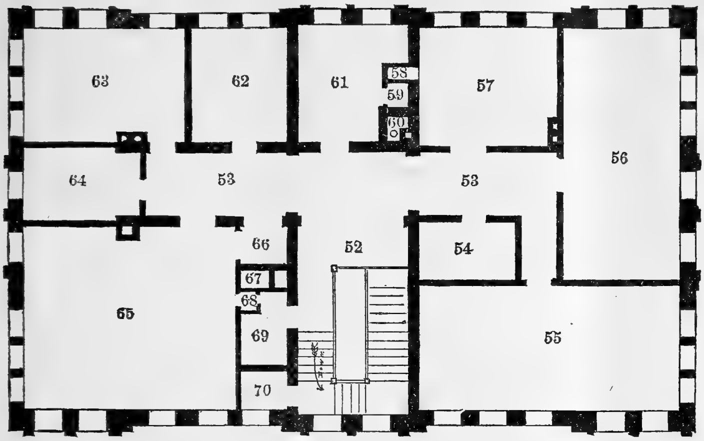


FIG. 3.—52, 53, hall and corridor; 55, experimental physiology of lower animals; 56, advanced histology; 57, workshop; 54, balance-room; 61, assistant's room; 62, myograph-room; 63, director's private room; 64, dark chamber; 65, experimental physiology of mammals; 66, elevator; 60, 67, ventilating-shafts; 69, closet; 70, lavatory.

and a chemical table. The latter is supplied with the reagents and appliances for practical work in elementary chemical physiology. The dissecting-table is for the dissection of animals, such as cats and dogs, which are of a size not to be conveniently handled at the regular work-places on the wall-tables: it has a slate top, and is provided with a sink and water-tap between every two students. The inner side of the room has, against the wall, tables for scales and the warm-water oven; a large hood for the performance of chemical operations calculated to give rise to noxious vapors; and a dumb-waiter leading to the basement, on which articles can be sent up from the store-rooms there when called for. Near the centre of the room is a chute, lined with plate-glass (so as to be readily kept clean), and passing direct to the furnace-room below. Through this chute all refuse is at once got rid of. The floor of the room, and of all others in the building in which messy work has to be done, is of asphalt, and the walls of hard cement to a height of two and a half feet. Thus no spilled blood or other offensive matter is absorbed; and the floor can be flooded with water, and thoroughly cleansed, whenever desirable.

The work to be done in this room annually is as follows: by first-year students, a thorough macroscopic and microscopic examination of about twenty-five selected vegetable and animal organisms illustrative of the course of lectures on general biology, and a study of the embryology of the chick; by second-year students, a course in practical animal physiology and histology a little more extended than that given in Foster and Langley's 'Practical physiology,' but essentially similar to it, and the thorough dissection of a dog or cat.

The second floor (see plan, fig. 2) contains the following rooms: a laboratory for research and advanced study in animal morphology, and a corresponding room for botanical work; a photographing-chamber, with heliostat and other appliances for micro-photography; a library of biological text-books, monographs, and journals; a small lecture-room (to be used for the present as the laboratory of psycho-physiology) capable of seating about thirty; an assistant's private room; a museum containing such typical osteological and other

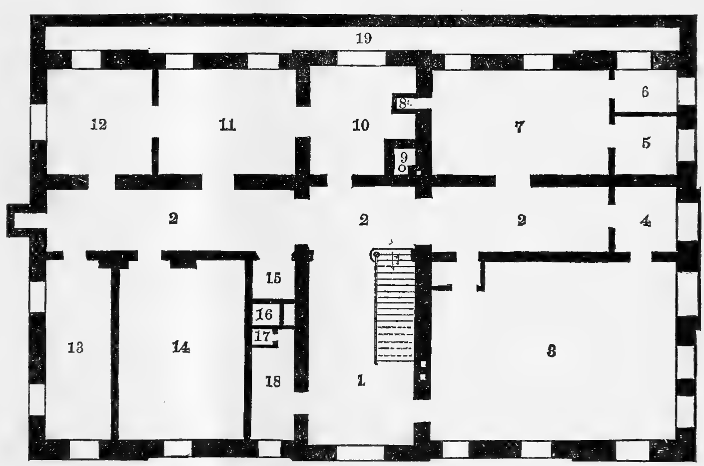


FIG. 4.—1, 2, entrance and corridor; 3, chemical physiology; 4, balance-room; 7, furnace-room; 10, 11, 12, janitor's store and battery rooms; 13, animal-room; 14, electro physiology; 15, elevator; 16, 9, ventilating-shafts; 18, lavatory.

specimens as are needed by students pursuing the regular courses of class-instruction, and the beginning of a collection of the local fauna

and flora, made by the members of the field-club; and a store and preparation room for the curator of the museum.

The third floor (see plan, fig. 3) contains three main work-rooms for advanced students, — one for animal histology, one for physiological experiment on invertebrates and the lower vertebrates, and one for experiments on warm-blooded animals. The room for the latter purpose communicates directly with the hydraulic elevator, which has also doors opening directly on the corridor of each floor, and runs to the basement: there is consequently no carrying of animals or their remains up or down the stairways. The other rooms on the third floor are, a dark chamber for spectroscopic work, for experiments in physiological optics, etc.; the director's private room; a room for the myograph; an assistant's private room; the mechanics' shop, for the construction and repair of instruments; and a small balance-room, containing also a case with a supply of chloral, curare, morphia, and other drugs frequently employed in physiological experiments.

The building being heated by steam supplied from a boiler in the neighboring chemical laboratory, the basement (see plan, fig. 4), which is well lighted, is left free for use. The scientific work-rooms in it are, a large, well-equipped room for advanced study in chemical physiology, a balance-room, and a room for the study of animal electricity. The basement also contains a suite of three rooms, which form the janitor's headquarters, where he has charge of the necessary stock of chemicals and glassware, and has also a carpenter's bench, at which he does any simple bit of carpentering required. From one of these rooms a shaft two feet square runs to the top of the building, communicating with each floor. Through this shaft it is intended to run wires to various work-rooms, transmitting electrical currents for the running of chronographs, and for similar purposes. The shaft was also planned in the hope that ultimately the clock-work of kymographs and such instruments will be replaced by electrical energy generated by an engine and dynamo in the basement, and distributed thence over the building.

FIG. 5.

The remaining rooms in the basement are, the 'animal-room,' fitted up with tanks for the keeping of frogs, terrapins, and so forth; and the furnace-room. The latter contains a cremation-furnace, in which all the combustible *débris* of the laboratory is disposed of, and a boiler and condenser for the preparation of distilled water: it has also in it a small steam-engine, designed to be used for running a centrifugal apparatus.

In the general internal fitting-up of the laboratory, the trustees of the university have acted upon the belief that it is, in the long-run, more economical to provide students with furniture which is good and attractive, and trust them to take care of it, than to supply cheap tables and cases, which the average undergraduate, at least, is apt to feel no hesitation in mutilating. The halls and lobbies are comfortably covered with cocoa matting; the tables, instrument cupboards, and cases of drawers are of polished cherry. But there has been no attempt at ostentation: the furniture is all simple, though handsome, and finished in every essential in the best manner. Every drawer runs as smoothly as in the best cabinet work; and each has its own lock, to be opened only by its own key, or the master-key for each floor kept in the administration-room.

The library is a little more luxuriously furnished than the other rooms. It is carpeted, and supplied with armchairs. So many students can only afford to hire rather uncomfortable lodgings, that it was believed desirable to provide in the library a really pleasant study, in which they might find at hand, not only the books they wanted, but writing-tables and other conveniences. None of the books are locked up. The student, on entering, finds before him a list of books which are not to be taken from the room, including text-books, monographs on the plants or animals which are used as types in the regular class-instruction, and the last-received numbers of periodicals: all other books may be taken (subject to call for immediate return at any time) on the student writing his name, and the title of the book he desires to take away, on a card provided for the purpose, and then slipping this through a slit in a locked drawer. The fellows and scholars in the biological department act in turn as librarians for the day, and are present

FIG. 6.

at a stated hour to receive books returned, and restore the receipts for them: until the card is returned to its signer, he is responsible for the book. This system of almost absolute freedom in taking books from the library is still on its trial: it has now been in practice for four months, and with the best results. Those who desire to take books home appreciate the trust reposed in them, and also the convenience to them of the present plan, and are anxious to secure its continuance.

The principle on which the library is managed, of inviting students to co-operate with the administrative officers in making it possible to allow the freest use of all books in it compatible with their safety, has been extended to the instruments in the various rooms for advanced work. On admission, each man has assigned to him a microscope, microtome, other histological appliances, and such chemical glassware as he is pretty certain to need. For these he signs a receipt, undertaking to restore the articles in good order on demand, or pay a specified sum for them. Glass slides and covers are purchased in quantity, and supplied by the janitor at cost. Other glassware, only occasionally needed, is supplied to any member of the laboratory on requisition, the recipient signing an agreement to return or pay for it. With these exceptions, free use of all instruments required for such work as he has been permitted to undertake is allowed to every student, on condition that upon removing any piece of apparatus from its drawer or cupboard he shall leave in its place a card bearing his name. The only alternative, of course, is to lock every case, and only issue apparatus on formal application to a special officer. The men are on their honor, and also know, that, if instruments cannot be traced, the present system must cease. Hitherto the endeavor to secure their aid in carrying out this plan of making all the apparatus accessible with the minimum of trouble or delay, has had most satisfactory results; largely, no doubt, owing to the fact that the majority of the students are graduates old enough to have a sense of responsibility, and to influence the younger men. Once a month one of the fellows, or graduate scholars, examines the instrument cupboards in each room, compares their contents with the inventory, notes what piece of apparatus has been taken and who has taken it. If any instrument is not accounted for, he posts a notice asking who has it. During the past four months the latter proceeding has been necessary only three or four times, when students had, in the hurry and excitement of an experiment, forgotten to write the required receipt: in every such case the delinquent has at once come to apologize and explain. What may be called the 'permanent' apparatus in the laboratory, as distinguished from glass tubing and other perishable 'current' apparatus renewed yearly, has cost more than ten thousand dollars: about fifteen hundred dollars are annually provided for repairing and adding to it. During the current year another five hundred dollars has been placed at the disposal of Dr. Stanley Hall for the purchase or construction of apparatus for psycho-physiological teaching and research. This stock of instruments is so valuable, and in many cases so easily injured, that a longer trial will, of course, be necessary, before it can be decided whether the present system of leaving every thing unlocked, and trusting students to leave an acknowledgment for such instruments as they take, can be continued without undue risk of loss or injury by carelessness for which no one can be found responsible.

The work for which the laboratory has been planned and built was stated in Professor Martin's lecture, published in our issues of Jan. 18 and 25. Briefly, it is the training of beginners in biology in the fundamental properties of living matter, and the structural and physiological characteristics of the chief groups of plants and animals; in co-operation with the seaside laboratory of the university, to afford opportunities for advanced study and research in animal morphology and embryology; and, ultimately, similar opportunities for advanced students of botany. In addition, very special attention has been given to providing facilities for class-instruction, advanced study and research in animal physiology and histology, and opportunity for such senior students as intend to become physicians to learn the methods of experimental pathological and therapeutical research, so far as they can be carried on in a laboratory. It is hoped that in this way the biological laboratory may prepare annually some students to enter special laboratories of pathological or pharmacological research more immediately connected with a medical school.

SOME PECULIARITIES OF PLANT-GROWTH.

THE following cases are here placed on record as affording interesting instances, not only of the ability of plant-tissues to repair injury, but of the enormous power exerted by vegetable structure during the process of development.

In the summer of 1873 I discovered a very interesting case of the lifting-power exerted by roots during growth, and in 1875 called the attention of my friend, Col. W. S. Clark, to the fact. He made measurements of the various parts, and noted the case in the *Scientific farmer* of Oct. 1, 1875. I cannot do better than reproduce his description, as follows: —

"On a ledge of coarse granite in the town of York, Me., stands a black birch (Betula lenta) which is about forty feet high, with a trunk two feet in diameter. The seed from which it sprang germinated in a narrow seam of the rock at a point eight feet from the ground in a perpendicular direction, and some fifteen feet along the line of the seam, which descended at an angle of forty-five degrees. The first rootlets of the young plant penetrated the seam until they reached the earth, from which supplies were to be drawn for the nourishment of the future tree. The mass of rock above the roots was more than fifteen feet long, from five to ten feet wide, and from one to three feet thick." Its weight was thus very nearly twenty tons. "Only two slender rootlets undertook the task of lifting and carrying this enormous load. One passed down nearly under the centre of the rock; and the other, two or three feet from the first, and so near the edge that at one point it has been forced out from under the rock, forming a sheet eighteen inches in width. The base of the trunk where it enters the seam now measures four feet in width and one foot in thickness. The mass of rock has been elevated twelve inches, and carried sideways eight inches by the expansive power of these two roots, which have not only borne this immense burden, but have supplied the crude sap for the development of the tree. It is but trifling to add the fact that they have not only raised the rock, but also the entire tree, from an eighth to a quarter of an inch every year."

The man on whose land this was found said he well remembered the time when it was impossible to insert his finger in the widest part of the seam. This is only one of the many similar cases which occur naturally, and is not more striking or suggestive than the force exerted by the mammoth squash in lifting a five-ton weight.[1]

In 1875, when carrying on some experiments with the squash-vine, it became necessary to remove the young squashes. This was accomplished by passing a knife through the stem of the squash, leaving the latter in position for future collection. One squash, though cut from the vine, was overlooked in the first collection; and, when the final harvest was made, it was discovered firmly united to the stem, and of a very good size. Upon careful examination, both outwardly and under the microscope, it appeared that (1) when the cut was made,

A BLAZE WHICH HAD BEEN COVERED BY MANY YEARS' GROWTH.

the squash was not displaced, and the cut surfaces immediately came together again; (2) as determined by a 'fault' in a crack of the epidermis, the squash rotated in position as the cut was made, thus accomplishing a displace-

[1] Clark, Phenomena of plant-life.

ment of nearly one-fourth of an inch on the surface of the stem; (3) the healing was complete in the interior, but the line of section was plainly visible under the microscope; (4) there was a displacement of the vascular bundles corresponding with the surface displacement; (5) the epidermis dried and shrank away before union could be completed, and there was thus left a V-shaped groove which extended completely round the stem, and demonstrated the completeness of the section in the first instance.

In the Redpath museum of McGill college there is a most interesting case of an old blaze on a beech-tree, which, in the course of a few years, came to be completely covered by the new growth. The specimen came originally from Belle Rivière, county of Two Mountains, and was discovered when cutting up the tree for firewood. It was exhibited before the Montreal natural history society, at its meeting in April, 1882; but no special description of it was published.[1] It is therefore thought desirable to figure and describe it here (see preceding page).

The figure, as blazed, is shown in the accompanying drawing; and its general character shows that it was probably made by one of the early Catholic missionaries, who little dreamed that it would be so effectually preserved. An examination of the stump showed by actual count at least one hundred and sixty rings of annual growth external to the blaze; and the size of the original tree is still clearly defined, showing that it was four inches and a half in diameter.

Two impressions are to be observed, — one representing the original marking; and the other, a cast from it, made by the overgrowing wood; both being very clearly defined. We have to note the following: —

1. That the figure was cut with a knife, as shown by occasional incised lines; though the outer cast, being in black, at first leads one to the belief that a hot iron was employed. Upon closer examination, however, it seems more probable that the black or carbonized portion was the result of slight decay, the decayed portion being subsequently covered up, and thus producing the appearance described.

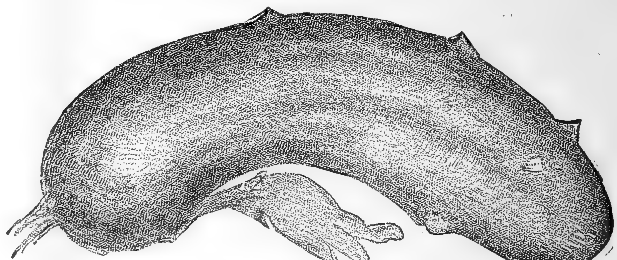
2. That the destruction of the bark and cambium was strictly confined to the lines of the figure, the intermediate portions still retaining their vitality and power of growth.

3. As now seen, the figures of the original blaze are defined by a stronger localization of coloring-matter in the wood, along the entire outlines, as shown in the drawing.

4. This offers a very good illustration of the tendency of active vegetable tissues to heal over abraded surfaces, and repair injury, the degree of reparation depending upon (*a*) the special vigor of the plant, and (*b*) upon the extent of the surface injured.

[1] Canadian nat., new ser., vol. x. no. 4, p. 238.

In 1879 I discovered a very interesting case of adhesion in a cucumber growing in the plant-house. My attention was not called to it until in an advanced stage of development,



FLOWER GROWING UPON A CUCUMBER.

as represented in the drawing, which is of full size. As is here seen, the monstrosity literally consisted of a flower growing upon a well-developed cucumber. As shown in the figure, the abortive flower was borne on a conspicuous peduncle, which became merged at its base with the base of the cucumber. The entire relation of parts would seem to indicate that there must have been two axillary flowers which became united in the early formation of the buds; one of them subsequently developing normally, while the growth of the other was largely arrested.

D. P. Penhallow.

McGill university, Montreal.

THE NATAL OBSERVATORY.

Mr. Edmund Neison, the government astronomer at Natal, submitted to the colonial secretary, in June last, his report on the Natal observatory, whose establishment has been mainly due to the active exertion of Mr. Escombe. It was decided to found the observatory in time to obtain observations of the then approaching transit of Venus of 1882; and, on being applied to, Mr. Gill, the astronomer royal at the Cape, furnished an estimate of the cost of a suitable establishment. A generous sum was secured at first by private subscription; and in June, 1882, the sum of three hundred and fifty pounds was voted by the corporation of Durban toward the expense of founding the observatory, and the next month this was supplemented by a special vote of

five hundred pounds by the legislative council. In all, a sum of about nineteen hundred pounds was contributed.

Under the superintendence of Mr. Robert Pett, of the Cape observatory, the new establishment was constructed, and the instruments erected. On the 1st of December, Mr. Neison took possession of the observatory as astronomer to the Natal government, and subsequently the observatory was taken over by the government of the colony. It lies on the south-west corner of the land originally granted for the use of the botanic gardens, and is a substantially built, rectangular red-brick building with cement facings, and carries a light wooden upper structure, forming equatorial and transit rooms. At present, there being no protection from the direct rays of the sun, the substantial walls of the observatory become so hot in the day, that it will be difficult to obtain proper observations until the building is completed by the erection of a veranda to shield the walls, and prevent their becoming so intensely heated. Having become thus raised in temperature during the day, the walls, owing to their massiveness, require the greater portion of the night in which to cool; and during this time they give rise to convection-currents of heated air, which render it difficult to secure satisfactory observations with any of the instruments.

At the time of Mr. Neison's report, the principal instruments of the observatory were: a fine eight-inch equatorial (by Grubb), the gift of Harry Escombe, Esq.; a high-class three-inch transit instrument, purchased by the government; an excellent sidereal clock, originally constructed for the Royal observatory, Greenwich, and at present lent by the Transit of Venus commission to the astronomer; and two chronometers, the one a sidereal, and the other a mean time. Mr. Neison describes these instruments, and reports their satisfactory performance. The observatory is at present without the usual equipment of meteorological instruments, but they will be obtained from England in the course of the spring.

Mr. Neison remarks upon the necessity of having proper steps taken for transferring in a regular manner to the Natal government the observatory and its site. It is built on ground originally assigned for a botanic garden, with the understanding that a sufficient space should be set aside for the purpose as might be deemed sufficient by the astronomer, though no written agreement to that effect was thought necessary. Owing to the nature of the ground, — a hillside covered with brush, — it is imperative that the astronomer (for the time in charge) should have every authority and complete control over the ground to the north and north-east of the observatory, which must be his chief observing-region; for otherwise he may be seriously hampered in carrying on his scientific work. The trees and other vegetation upon the surface of the ground have a far greater influence upon astronomical observations than in merely cutting off the view of a small portion of the heavens; this influence extending over the atmosphere for a considerable distance above them, owing to their liability to establish air-currents and tremors which are fatal to accurate observations. Experience has shown it to be not unfrequently necessary to clear the ground of particular kinds or groups of trees and shrubs, which establish such currents from being out of harmony in temperature and radiation-constants with the surrounding surface. Pines, laurels, and rhododendrons have had, on this account, to be removed from the environs of more than one observatory. Even the watering of the ground will give rise to most injurious convection-currents at times. When the moisture is general, as after a rain or heavy dew, it is of far less consequence; but when it is partial, as in watering plants, each plant sets up its own convection-current, and thus causes objects to appear most unsteady when seen through the air above, and so ruins accurate observation. Taking all things into consideration, Mr. Neison regards it as certainly most unwise to cramp the observatory and its future by confining the site set apart for its use to a smaller area than three hundred by seventy yards, both measured horizontally. A mere partial control or divided authority over this area, or any portion of it, would be unwise; for it would be sure to lead to complications and conflict of authority — if not in the immediate future, for a certainty at no long-distant date.

The Natal observatory has taken vigorous measures for the distribution of time-signals throughout the colony. At one o'clock every day a signal is sent to the central telegraph-office at Durban, from which it is distributed all over the colony, firing a time-gun and dropping a time-ball at Maritzburg, and also one at the Point, Durban. It is proposed to extend this system by the addition of a time-gun in the centre of Durban; to establish time-balls at Newcastle and Stanger; and, in connection with the Natal harbor board, to establish a system for properly regulating and rating ships' chronometers, similar to that already in existence at Liverpool and elsewhere.

In observing the transit of Venus the astronomers were moderately successful, no observations being undertaken outside of the usual optical ones. Copies of all the observations have been duly transmitted, through her Majesty's astronomer at the Cape, to the Transit of Venus committee at Burlington house, London.

With regard to tidal reductions, it has been arranged with the Natal harbor board that the tidal observations which are being made at Natal shall be reduced in the colony under the superintendence of the observatory, and proper tidal-tables constructed.

With reference to the future work of the observatory, it is proposed to take advantage of every opportunity for carrying out a series of observations of the moon, with a view of obtaining data for perfecting the tables of the motion of our satellite. The duty of making standard meridian observations of the moon is fully carried out at the Royal observatory, Greenwich, and partially at the Radcliffe observatory, Oxford, and at the U. S. naval observatory, Washington; but, for obtaining the full information necessary for properly discussing these observations so as to make them available for per-

fecting the theory of the motion of the moon, it is necessary that a considerable number of auxiliary observations should be made. These, it is proposed, should be made at the Natal observatory with the greater facility, as all the lengthy mathematical analysis necessary for their reduction has already been executed by Mr. Neison himself. The principal subjects already taken up at the observatory are the following: —

1°. The determination of the exact amount of the parallactic inequality in the motion of the moon by means of observations of the position of a crater near the centre of the lunar surface.

2°. The determination of the exact diameter of the moon by observations of pairs of points near the limb.

3°. The effect of irradiation and its variations upon the apparent semi-diameter of the moon.

4°. The systematic variation in the apparent place of the moon produced by the irregularities on its limb.

5°. The real libration of the moon by a method independent of the errors caused by abnormal variations in the apparent semi-diameter of the moon.

The first investigation is in continuation of the one already commenced at the Arkley observatory, England, and will be carried out with the additional co-operation of the observatory of Strasburg, Germany. Arrangements are being made to obtain the co-operation of the Cape and other observatories in the investigation of other of the above subjects.

ECONOMY OF FUEL IN IRON-MANUFACTURE.

As the price of iron falls, every item in the cost of its production is more and more carefully scrutinized, — the quality of the ore, the cost of transportation, the labor used at the various steps in the process, the accessories and mechanical appliances, the rapidity of working, the quantity of fuel to the ton of pig-iron produced, and the cost of the fuel. Of all these, the cost and quantity of fuel used are, perhaps, receiving the largest share of attention from the iron-men just at present.

One coal-saving device is the Gjers soaking-pit. Formerly the huge ingots of steel from the Bessemer converter were allowed to cool, and were again heated before rolling them into steel rails. The efforts to roll them while still hot failed, owing to the fact that the core might still remain fluid while the outside shell of the ingot was cooling even below the rolling-heat. The Gjers soaking-pit is a hole in the ground, walled with bricks, in which the ingot of steel is placed until it has uniformly cooled to the rolling-heat, thus saving the reheating-furnace. It is claimed that the Gjers soaking-pit saves sixty-seven tons of coal to a hundred tons of rails. Again: at the South Chicago works the pig-iron is run directly from the blast-furnace into the Bessemer converter; while the usual practice in most works has been, and still is, to allow the pig-iron to cool, and to melt it again in a special furnace for the Bessemer converter.

The above processes save in the *quantity* of fuel; while, on the other hand, a large saving in the cost of fuel is looked for in the improved methods of coking and in the recovery of the valuable by-products. It seems quite generally admitted, that a good system of coking, which will save the tar-oils and the ammonia, will pay all the coking-expenses.

The great national economy will be better understood from figures. In the year 1880, in the United States, 2,752,000 tons of coke were produced from 4,360,000 tons of coal by the old-fashioned beehive oven. Two years ago the figures for Great Britain were 7,000,000 to 8,000,000 tons of coke from nearly 13,000,000 tons of coal by beehive ovens. This quantity of coke could have been produced by the Simon-Carvès system of coke-ovens from 10,000,000 tons of coal; effecting a saving of 3,000,000 tons, and also a saving of the coal-tar and ammonia by-products.

The beehive oven, which takes its name from its form, is a low, square chamber with dome-shaped top; has an opening for escape of gases at the top, and a door in the side through which to admit the air, to charge the coal, and to discharge the coke. The burning is regulated by opening and closing the side-door, and all the gases go to waste at the top. The Simon-Carvès system of ovens consists of a row of chambers side by side, with combustion-flues in the parting-walls and under the floors. The waste-gases are burnt in these flues, and liberate heat enough to distil the gases of the coal. These gases, before entering the combustion-flues, are passed through condensing-apparatus, where the tar and ammonia by-products are saved. The two ovens, therefore, work upon totally different principles. The beehive cokes by slow combustion, sacrificing a portion of the coal by the door, as well as the by-products: the Carvès simply distils. The beehive saves 60% to 65% of the coal as coke: the Carvès saves 75%. The beehive oven produces a very fine coke, in long, columnar, hard, silvery, porous masses: the Carvès gives a dark, dense, heavy coke. And it is here that the iron-master hesitates; for he likes the silvery, porous beehive coke for making iron, and does not yet accept the dense, heavy coke of the Carvès oven.

Jameson has invented an oven which is known by his name, and which is essentially a beehive oven, with a suction-pipe entering at the bottom instead of the roof-outlet for gases. The products of combustion are drawn by an artificial draught through the pipe; and, after being carried through apparatus for the condensation of the by-products, this gas is available for any purpose. The actual yield from a ton of coal has been estimated to be: sulphate of ammonia, 10 pounds; oils, 8 gallons; gas, 12,000 cubic feet; coke, 67% to 69%. The tar from this oven is lighter than water (specific gravity, .960), and consists mostly of oils, boiling between 250° and 300° C., of little value as burning-oils, and of secondary value as lubricants. Paraffine is present, and both toluine and xyline in small quantities, but no benzine. A portion of the oils breaks up into phenols, which, so far as investigated, give colors of little stability. Neither naphthaline nor anthracine is present, both valuable as sources

of coal-tar colors; and, while this tar presents an attractive field for research, it is not of great value at present. On the other hand, the tar from the Simon-Carvès has a specific gravity of 1.20, is black and thick, rich in naphthaline and anthracine, contains benzine, toluine, xyline, and carbolic acid, and is free from paraffines. A good deal of benzol is supposed to be carried off and burned. Now, Mellor has recently patented a process for extracting benzol from gas by passing it up through an earthenware tower filled with broken glass moistened with nitric acid. Davis has also a process for refrigerating gases. Either of these processes, added to the present plant of the Simon-Carvès, would save valuable products for coal-tar colors.

It is generally the fate of new improvements, that some unforeseen difficulty stands in the way of immediate adoption. In this case the dilemma seems to be, that the iron-men say, give us beehive or Jameson coke and Simon-Carvès by-products, and we will embrace the improvement at once. But, while the Jameson coke is good, the by-products are not as yet of much value; and, while the Carvès by-products are valuable, the coke is not yet satisfactory. Improvements often are adopted partially, or in some modified form. So it appears to be in this case.

The furnaces at Gartscherrie, near Glasgow, Scotland, have for years been smelting with raw coal, allowing it to coke itself at the top of the furnace, thus losing all the by-products, and some of the coal itself. They have recently tried closing in the top of two of these furnaces, and conducting the furnace-gases through condensing-apparatus on the way to the boilers, hot-blast stoves, etc. They have been so much pleased with the result of the experiment, that they propose to apply the same improvement to the other eight furnaces. This arrangement will probably yield a much heavier oil than the Jameson oven, but perhaps not so heavy as the Simon-Carvès; and, as the coke is made within the furnace itself, it is hard to say just what its quality may be.

Report says that modified plans are being tried in still another way, and that the highly bituminous coals of Colorado are treated by a process of coking; and the derived gas is injected into the blast-furnace, and thus re-enforces the heat of the coke, which is mixed with the ore, as usual, and has thereby effected a reduction of 75% in the cost of the smelting.

R. H. Richards.

THE FLORA OF LABRADOR.

The list of the plants of Labrador published in the Proceedings of the U. S. national museum, vol. vi. pp. 126–137, is interesting as showing some facts of geographical distribution. Though the list makes no pretensions to being complete, still it may be considered that it represents the flora in a sufficiently complete form to allow inferences to be drawn from it.

There are enumerated, altogether, a hundred and sixty-one species and varieties. Of these, two, Ranunculus acris and Capsella bursa-pastoris, have been introduced from Europe. Of the hundred and fifty-nine left, a hundred, or nearly sixty-three per cent, are natives of Europe as well as of Labrador. Out of these hundred species, there are some having a more northern distribution than Labrador, and a few extend even to the Arctic circle. Many of them are marsh or swamp plants, or else live along the seacoast. The flora, as a whole, is most decidedly northern in its character.

Of the fifty-nine species not known to Europe, it is found that thirty-eight have a range to the northward of the 49th parallel, and that only about four (viz., Fragaria Virginiana, Kalmia latifolia, K. angustifolia, and Alnus serrulata) can be considered as southern forms. Of these, the first is 'rather rare,' the two Kalmias are found in 'ravines and near ponds in the interior,' while the last is found 'in ravines' and along the seacoast. The northern aspect of the flora is further illustrated by the following facts: —

The Ericaceae, an order most abundant in cold climates, has seventeen species; Rosaceae has eighteen species, ten of them belonging to the northern genera Potentilla and Rubus; Caryophyllaceae has eleven species and varieties; while the Labiatae has not a single one, the Borraginaceae has only one, Scropulariaceae but two, and Compositae is sparsely represented by four.

This last seems an especially striking fact, and is in accordance with what we might expect. We know that the order is largely a tropical one, and that probably the heat of the summer months in Labrador is not sufficient, and not long enough continued, to enable the plants to flower and fruit. Of the Leguminosae, there are only five species, four of them being European also; and this order may be regarded as being in the same category as the Compositae.

In a former article (Indigenous plants common to Europe and the United States, *Journ. Cinc. soc. nat. hist.*, iv. p. 51), I have endeavored to show that we must look to the north as the place of origin of many of our plants; and when we find that sixty-three per cent of Labrador plants are also European, and twenty-three per cent have a high northern range, some extending to Alaska and Greenland, we see further reason for the assertion. That many of these plants were at one time distributed all around the Arctic circle, there can be no doubt; and that they have been driven from their first homes by the excessive cold, and found suitable abiding-places at the south, must also be considered as an established fact. The agent in this pushing-southward of northern forms may be regarded as the glacial period, when the presence of the immense mass of ice on the continent caused the flora to continue to retire farther and farther south as the cold became more and more intense: when it mitigated, many of the plants returned north, and established themselves as near as they could to their original homes.

Jos. F. James.

THE HALL PHENOMENON IN LIQUIDS.

PROFESSOR ANTONIO ROITI publishes (Atti acc. lincei, xii. 397) under the above title the results of some experiments he has made. In preparing himself for his work, he repeated some of the ordinary experiments upon this phenomenon in metals: and the results, which contain nothing new, are shown in several diagrams. He devised one new experiment, however, which shows, as he thinks, that the effect he is investigating is not due to a direct action of the magnetic field upon the electric current *per se.* As the opinion thus reached by Professor Roiti must have been held two or three years by all who have given special attention to the matter, it is hardly worth while to inquire whether his new experiment is conclusive in itself.

In experimenting with liquids, Professor Roiti was unsuccessful in his main object, no effect similar to the well-known action in metals being detected.

It did appear, however, that the magnet, acting upon a solution of sulphate of zinc of given strength, was able to produce a change in the electric conductivity of the solution, the sign of which depended upon the direction of the magnetic force, the current in the liquid, and the degree of concentration of the solution. Thus, in a solution less concentrated than that which possesses the maximum electric conductivity, the effect was in a certain direction; while the opposite effect was produced, under the same conditions of current and magnetic force, in a solution having a concentration greater than that corresponding to this maximum. In a saturated solution no similar effect was observed.

Professor Roiti attributes this behavior of the non-saturated solutions to a want of homogeneity in the liquids, which become stirred up by the ponderomotive electromagnetic action. He makes several experiments tending to support this opinion. In a solution of ferric chloride (*cloruro ferrico*), of specific gravity 1.34, effects were obtained similar to those found with the dilute solution of sulphate of zinc. In a thin layer of mercury no similar effect was detected.

The examination of liquids with the view of detecting a 'rotational effect' similar to that observed in metals was probably first suggested in print by Ettingshausen.[1] The difficulties of the investigation were obviously great, however; and Professor Roiti appears to be the only experimenter who has yet undertaken it.

His account of his experiments is open to criticism in this respect: that it does not give sufficient data in regard to intensity of magnetic field, etc., to enable the reader to determine how severely the liquids were tested for the presence of the effect which gives the title to his article.

Moreover, he seems to have made a point of placing his side-connections unsymmetrically, so as to have, independently of the magnet's action, a considerable 'derived' current, — an arrangement which enabled him to discover the effect described above, but which, on that very account, should be studiously avoided in seeking for the phenomenon he was trying to detect.

[1] *Anz. akad. wissensch. Wien*, March, 1880.

Professor Roiti's ultimate object in beginning this investigation was to determine whether the transverse or 'rotational' effect would in liquids correspond to the magnetic rotation of the plane of polarization of light. Of course, no conclusion whatever upon this point can be drawn from the account given of his work and its results. And, even if his experiments had been entirely successful in revealing the effect looked for, it would be necessary to exercise caution in applying results so obtained to the case of the rotation of light. In the liquids, as here examined, the particles have time to fully adjust themselves, in position and motion, to the requirements of the magnetic force and the electric current to which they are subjected; while in the phenomenon of light, assumed to be electromagnetic in character, the mere inertia of the particles of the liquid must play an important part in the action of forces, which are reversed a countless number of times every second.

In the *Comptes rendus* of Sept. 17, 1883, Professor Righi states that he has found the Hall effect in bismuth to be of the same sense as in gold, but about five thousand times greater than in the latter metal. He obtains a very marked action in bismuth by use of an ordinary bar-magnet, and believes that he can produce a perceptible effect by the action of the earth's magnetism.

JANET'S THEORY OF MORALS.

The theory of morals. BY PAUL JANET. Translated from the latest French edition [by MARY CHAPMAN]. New York, *Charles Scribner's Sons*, 1883. 10 + 490 p. 8°.

IF books on ethics are to be noticed at all in a scientific journal, they might be, as a rule, safely classified under the head of fossils. No literature deals with a subject which would seem to be more living; yet no literature is, on the whole, more desiccated and dead. Human conduct, with all its infinite variety of standards and impulses, with all its marvellous interworking of passions and emotions, with all its pressing and personal problems, conflicts, and obligations — what subject would seem to stimulate students to greater vividness, picturesqueness, or incisiveness of treatment? Every man is in his own way an ethical philosopher. No one can escape thinking about the right principles of his conduct. Books on this subject address the largest possible audience on the one unavoidable subject of reflection. And yet there seems to be some subtile influence which dries up even literary instincts when they approach this theme and which makes even brilliant writers wearisome. There

is hardly any living English writer more abounding in vitality and wit than Mr. Leslie Stephen; but even he, when he enters this enchanted region, seems benumbed and drowsy, and is positively hard to read. There is said to be no American teacher who has imparted more moral force to his students than the venerable president of Williams college; but, the moment he arranges his instruction in a book, it is as if he gathered his living flowers from useful and from noxious plants, and laid away these virtues and vices, all pressed and juiceless, in successive drawers.

The last work of Janet, which he frankly describes as his *Magna moralia*, is certainly as little open to these criticisms as any book of its kind. It attracted much attention on its first appearance in 1874, and was for some years used as a text-book in Harvard college. It is now translated, and very well translated, for the use of President Porter's classes in Yale college. It has lucidity, as our last literary adviser would call it, and is full of learning. Its strength lies where the German masterpieces are weakest, — in force and variety of illustration. It is hardly extravagant to say that so clear and picturesque a treatise, in the hands of an alert teacher, might save the study of ethics from its almost inevitable fate of being very dull.

The stand-point of the author may be very briefly described. He is a conspicuous instance of the many minds who desire to be eclectics, but whose hearts will not permit them. He sees that the problem of ethics, like that of all present philosophy, is a problem of reconciliation. He sets himself to comprehend in his system the whole range of contributions to ethics made by modern utilitarianism, but he is none the less at heart a Kantian. The moral law of Kant appears to him too formal, too abstract, too empty, and he is repeatedly offering corrections and supplements; yet if Fichte is a disciple of Kant, so, in spite of frequent controversy with the master, is Janet. His first thrust is at the least-guarded part of the experiential method, — its incapacity to distinguish between quantity and quality in conduct. Here he discloses with ease the contribution which Mr. Mill has made to the view of conduct which he believed himself to be opposing; and we pass from the recognition of this distinction of quality in acts to the principle which alone can give quality to them. This principle he defines as their intrinsic excellence; and this excellence, in its turn, is to be judged by the contribution of acts to the unfolding of the best in man, — of his real personality, his reasonable will. Thus we find before us the moral dynamic of a completed life, the conception of an end in which happiness and excellence shall coincide, — in short, a moral ideal. This discussion occupies the first of three divisions in the treatise. The two remaining books unfold this fundamental conception in its relation to outward standards of duty and to inward laws of life. They proceed with great clearness and almost with vivacity of treatment, and invite us in somewhat fragmentary fashion to a great variety of problems, both of metaphysics and casuistry, which we cannot here consider.

Returning to the main contribution of the book to the theory of morals, the present reviewer has no controversy to undertake with its evident purpose. The ideal aim which it presents is not stated with the frankness of Grote, or with the fulness of Green; yet it is as plain with Janet as with Grote, that man is essentially 'an ideal-making animal,'[1] and as certain, though not so plain, with Janet as with Green, that the development of the moral ideal is a personal and inward, and not a social, evolution.[2] What we shall here with some diffidence suggest, however, is the highly technical character of all these treatises, and, indeed, of the whole range of ethical literature. We repeat the impression with which we began this notice. Here is a subject which deals more directly than any other with the real and daily relations of life; yet, as we have just now tried to describe the purport of a remarkably lucid book, we have found ourselves forced into the language of specialists, and away from the methods of practical affairs. It is quite possible for a man to be a highly trained moral philosopher, and yet be a powerless adviser concerning a specific moral problem, so far removed has been the science of right conduct from the subject with which it is supposed to deal. Now, we maintain that a science of life should frankly take its start from the data and the problems of life, and should proceed inductively to analyze and classify these data, and to discover what may be their law. The literature of moral conduct may be at present divided into two distinct classes, — the books which deal with theory, and the vast and rapidly growing literature which deals with the practical conduct of social life. This latter department is largely the growth of the last few years. It may be called ethical sociology. It describes the duties one owes to himself and to society, — the duties, or, in the case of Pro-

[1] Grote on moral ideals, p. 46, ff.
[2] T. H. Green, Prolegomena to ethics, 1883, pp. 189, 201.

fessor Sumner's little book, the absence of duties, between social classes; the problems of charity, temperance, and all the varied aspects of moral reform. Now, between these practical applications of ethics and the books on ethical theory there lies an unbridged chasm. The maxim of Kant gets ample illustration: "Ideas without content are empty; observation without ideas is blind." [1] When sociologists approach any theory of morals, they exhibit an almost ludicrous ignorance, as when Professor Sumner interprets sympathy in the spirit of unconscious Hobbism. When, on the other hand, a student of the metaphysics of morals approaches a problem of practical conduct, he is apt to find his law unmeaning. Here, then, it would seem, is an opportunity for what may be fairly called inductive ethics. It is not the method which commonly claims this name, and which simply means the exclusion of any evolution of personality; it is the construction of a theory of ethics from an examination of the facts of social life, the data of philanthropy, the testimony of ideal aims, the characteristics of moral personalities. This would be a method of ethics which would be constantly close to life, and which would gather up the real issues of conduct into their higher significance and tendency.

Francis G. Peabody.

[1] Kritik der reinen vernunft, s. 81, ed. Hartenstein.

BACTERIA.

Bacteria. By Dr. Antoine Magnin and George M. Sternberg, M.D., F.R.M.S. New York, *Wood*, 1883. 19+11+494 p., 12 pl., illustr. 8°.

This portly and handsome volume will be read with interest by all who have followed the painstaking and thorough work of Dr. Sternberg during the last three or four years. To him belongs the credit not only of having translated and published, in 1880, Magnin's useful book on the bacteria, but of having applied himself with tireless devotion and very considerable success to the actual work of laborious researches, often made under discouraging circumstances, and with little genuine sympathy from his fellow-countrymen. Dr. Sternberg is at the head of the American school of working bacteriologists, if, indeed, he is not its only member; so that any work coming from his practised hand should meet with a hearty welcome.

The present volume, which might well be called a handbook of bacteriology, is made up partly of Magnin's older treatise referred to above, and partly of new material supplied by Dr. Sternberg. Magnin's account of the morphology and the physiology of the bacteria, covering one hundred and fifty-two pages, is preserved intact. The rest of the older book is omitted; and in its place we have four 'parts' written by Dr. Sternberg, and discussing respectively, 'Technology,' 'Germicides and antiseptics,' 'Bacteria in infectious diseases,' and 'Bacteria in surgical lesions.' These, taken together, make up more than one-half the book.

Of Magnin's work it is not needful to speak. His book is familiar. We may turn, then, to the parts prepared expressly by the American author. Under 'Technology' we have a succinct but clear account of the various methods of collection, of cultivation, of staining and of photographing the bacteria, and of the attenuation of virus. Of most of them the author speaks from experience; and this chapter will be of the utmost value to the student and the investigator. Of course, in a subject like this, intricate and refined to the last degree, actual personal guidance is essential, or, at least, highly desirable; and we believe that Dr. Sternberg has given enough of the technology to help, but not enough to harm, the student.

Under the head of 'Photography' (p. 194) the author says,—

> "It is but fair to say that satisfactory results can only be obtained by the expenditure of a considerable amount of time and money, as the work must be done with high powers, and the technical difficulties to be overcome are by no means inconsiderable. The illustrations in the present volume may be taken as fair samples of what may be accomplished, and it will be found easier to criticise these than to improve upon them."

The plates are, indeed, of an unusually high order; the heliotypes of human (yellow-fever) blood being something remarkable, and not likely to be improved upon at present.

Under the head of 'Germicides and antiseptics' we observe at the outset (p. 210) the following conspicuous finger-post:—

> "If it were proven that the infectious character of every kind of infective material depended upon the presence of a specific living germ, as has been shown to be true in the case of certain kinds of infective material, *germicide* and *disinfectant* would be synonymous terms. Although this has not been proved, it is a significant fact that all of the disinfectants of established value have been shown by laboratory experiments to be potent germicides."

Numerous original experiments are here recorded; and the author agrees with the other authorities in giving little germicide value to most common disinfectants, and in pointing out the extraordinary efficacy of mercuric bichloride.

Besides a dozen or so of pages devoted to the *rôle* of the 'Bacteria in surgical lesions,' and having chiefly a medical interest, the rest of the book is devoted to a long and careful treatment of the 'Bacteria in infectious diseases,' and to the literature of bacteriology. These and the part on 'Technology' include the cream of the work.

At the start the author incidentally draws a subtle distinction, which may or may not be generally acceptable (p. 236), —

"The practical results of etiological studies, so far as the prevention and cure of disease are concerned, are likely to be much greater than those which have been gained by the pathologists;" —

adding directly in a tone of liberal conservatism, which no one can help admiring, especially as it comes from one who is in the advancing column, —

"and if the time ever comes, as now seems not improbable, when we can say with confidence, infectious diseases are parasitic diseases, medicine will have established itself upon a scientific foundation. But this generalization, which some physicians think is justified even now by the experimental evidence which has been so rapidly accumulating during the past decade, would, in the opinion of the writer, be premature in the present state of science. And for the present it seems wiser to encourage additional researches, rather than to attempt to generalize from the data at hand. . . . Those who have had the most experience in this difficult field of investigation are commonly the most critical and exacting with reference to the alleged discoveries of others."

Dr. Sternberg sees clearly enough that one of the most interesting theoretical questions in this whole subject which remains still unsolved is, how does inoculation or vaccination protect? or, in his own words, what is "the rationale of the immunity produced by protective inoculations? . . . Recovery, after inoculation with attenuated virus, is more easy to understand than is the subsequent protection" (p. 241).

Lecturers upon the subject often pass lightly over this point, and, by a comparison with a fermentation in a barrel of cider for example, say, "And just as a barrel of apple-juice can ferment but once under the same germ, so a man usually has the small-pox but once;" the idea being implied, that, as the alcoholic ferment has eaten up its food in the barrel, so the hypothetical small-pox plant has taken out all the available food-material from man, its living prey. Pasteur maintains a position like this; while Sternberg denies that it is a satisfactory explanation, and brings forward a lengthy argument in opposition, some of the points of which do not seem to us well taken. It is, however, the sufficient and fatal objection to the line of thought outlined above, that, while the barrel of apple-juice is a not-living medium, the living organism is undergoing constant repair, is even growing (in the technical sense) till death comes, and is therefore no fixed quantity, either in composition or condition. Dr. Sternberg would solve the problem by considering the acquired protection to be a 'tolerance,' a 'resistance' of the protoplasm to the new condition; e.g. (pp. 248–249), "during a non-fatal attack of one of the specific diseases, the cellular elements implicated, which do not succumb to the destructive influence of the poison, acquire a tolerance to this poison."

This would explain a temporary immunity, — would prevent a patient from 'giving' the disease to himself over and over again, — but would not explain a lifelong immunity, since new, and perhaps non-tolerating, non-resisting cells are being constantly produced from the old ones. The cells which actually suffered are therefore supposed by Dr. Sternberg to "acquire a tolerance to this poison, which is transmissible to their progeny and which is the reason of the exemption of the individual from future attacks of the same disease."

This hypothesis is certainly clear, and it is only befogged by the author's illustration (?) drawn from budding and grafting.

In view of the fact that bacteria are now believed to do their work largely by producing a genuine not-living poison which affects the living cells, the following is of interest: —

"The tolerance to narcotics — opium and tobacco — and to corrosive poisons — arsenic, which results from a gradual increase of dose, may be cited as an example of acquired tolerance by living protoplasm to poisons which at the outset would have been fatal in much smaller doses.

"The immunity which an individual enjoys from any particular disease must be looked upon as a power of resistance possessed by the cellular elements of those tissues of his body which would yield to the influence of the poison in the case of an unprotected person."

The reader must recollect, however, Huxley's discussion of 'aquosity' and 'horologity,' and remember that in such sentences as the following we are doing little more than formulating our ignorance: —

"The resistance of living matter . . . is a property depending upon vitality."

The question is often raised, Where do the pathogenic bacteria come from? Dr. Sternberg says in this connection, —

"If we suppose that under certain circumstances the conditions relating to environment approach those which would be found within the body of a living animal, we can easily understand how a micro-organism which has adapted itself to these conditions

may become a pathogenic organism when by any chance it is introduced into the circulation of such an animal. The culture fluid — blood — and temperature being favorable, it is only a question of superiority by vital resistance on the one hand, or by reproductive activity on the other.

"That harmless species of bacteria may develop pathogenic properties in the manner indicated seems extremely probable; and we should *a priori* expect that such a result would occur more frequently in the tropics, where the elevated temperature and abundance of organic pabulum furnish the favorable conditions required. In this way we may, perhaps, explain the origin of epidemics of pestilential diseases, such as yellow-fever and cholera. If these diseases do not at the present day originate in the manner indicated, they, at all events, have their permanent abiding-place in tropical countries."

Much space is properly devoted to the status of science regarding the individual diseases, and the treatment of them by the author is highly satisfactory. The volume closes with an admirable literature of the subject, for which all students will thank him. But in another edition he should add information as to where the papers of E. C. Hansen can be found. It would be better, also, to give the titles of German papers throughout in the German; and it surely is as needful to mention Schwann and Kützing as Cagniard de Latour, while the failure to record the translation of Schützenberger's work is a serious omission. Aside from these and other insignificant and pardonable errors, the bibliography is very satisfactory. The alphabetical arrangement which has been wisely adopted has one slight disadvantage: we miss the striking evidence of the growth of the subject, which a chronological arrangement such as was employed in the translation of Magnin's book in 1880, and which was in this respect impressive, gave.

On the whole, this book is the most practical, the most complete, and the most useful which we possess upon the subject. It is both a storehouse of principles and a handbook for the laboratory. If a physician or a student, a biologist or a pathologist, can have but one book, this one, because of its lucidity of style, its cool, cautious tone, its breadth and yet its comprehensiveness, and particularly because of its excellent illustrations, is emphatically the one to get. It is deeply to be regretted that Dr. Sternberg cannot be kept busily at work under every favorable condition at the expense of a country to whose service his life has been devoted, and that he is, on the contrary, obliged to write sentences so melancholy as these: —

"All this is admitted, and the experiment is introduced mainly to call attention to a method, which, carefully applied, should enable us to solve the question as to the pathogenic *rôle* of this micrococcus. The writer had mapped out for himself a series of experiments in this direction, and many others relating to etiological questions; but circumstances have not been favorable for the prosecution of experimental work, and he finds himself, somewhat reluctantly, engaged in a review of the field, when it would be far more to his taste to interrogate nature by the experimental method, and thus to aid directly in the solution of these interesting problems" (p. 447).

SCIENTIFIC LINGUISTICS.

Internationale zeitschrift für allgemeine sprachwissenschaft. Herausgegeben von F. TECHMER. Heft i. Leipzig, *Barth*, 1884. 16+256 p., 7 pl., illustr. 8°.

THIS new journal appears with an excellent though only partial list of contributors, representing various nations and languages. The articles may be in German, English, French, Italian, Latin, and, under exceptional circumstances, even in some other language; and the international character it is meant to have is perhaps the best justification for its existence. The editor, Dr. Techmer, *privatdocent* at Leipzig, has previously published a work on phonetics; and the most noteworthy article in this number is one by him on the same subject. Most, if not all, of the other articles might well enough have been published in already existing journals. They are all in German, except two in English (together occupying some twenty-two pages out of over two hundred and fifty) and one of about four pages in French. The writers are Pott (Einleitung in die allgemeine sprachwissenschaft), Techmer, G. Mallery (Sign-language, largely a reprint), Friedrich Müller, Max Müller (a short article in German on a Vedic name which he supposes to be identical with our word 'zephyr,' and to have been originally a name for the setting sun, zephyr meaning the west wind as coming from sunset), L. Adam (De la catégorie du genre), Sayce (The person-endings of the Indo-European verb), and Brugmann.

Techmer has two articles, — one devoted to the analysis and synthesis of audible speech; the other, to the transcription of sounds; both accompanied by illustrative figures and tables. The former is intended to give briefly what is known on the subject, and to add new contributions. The treatment of vowels is what is likely to interest phoneticians most in this latest work on the subject, especially its position with regard to the English school. It must occasion surprise, not that the English system is rejected, but that the arguments against it are so brief and insufficient; hardly any thing but Bell's work being considered, while

others, who have considerably modified Bell's system, are practically ignored. Sweet ought to have received careful attention; and Sievers surely deserved more than a curt footnote saying that the first edition of his book on phonetics had treated better than the second a certain class of vowels. The vowels meant have not yet been fully observed, but the Russian *jery* is one of them. Observations made several years ago in Leipzig, and renewed very recently in Boston by the writer of this notice, on the sound in question as pronounced by native Russians, are decidedly opposed to the theory accepted by Techmer; and Techmer's own hardly seem to favor it. That theory assumes that the sound is produced by *u*-position of the tongue, and *i*-position of the lips, while the English system makes it a vowel formed with the tongue in the 'mixed' position. In the present state of vowel-analysis, a correct account of this sound is of great importance, and vowels of the same class form one of the most marked features of the English scheme. Now, Techmer himself says he has only been able to observe a special form (*spielart*) of this class of vowels; namely, the Russian sound: and this he marks as formed with partially passive lips, like English vowels, and (sometimes only?) with an approach toward *mittlere zungenartikulation*. This comes very near the English description of the sound. The whole of Techmer's article is less clear and less interesting than Sievers's work, and makes the impression of resting more on theory than on unprejudiced observation of actual speech. To put, for example, *a* in the centre of the vowel-scheme must seem to many phoneticians a fundamental error. Still, the article contains much that is valuable, and is not to be neglected.

The second article, that on the graphic representation of speech-sounds, is open to objection for the same reasons. The account of English *e* in *err*, and *u* in *but*, certainly needed justification. They are represented as somewhat incomplete varieties of a sound to be classed with German *ö* and *ü*, — a statement which can only be accepted by one who agrees with Techmer as to the place of *a*, if, indeed, by any one. Also the English and American *r* sound ought to have been carefully distinguished from the rolled or trilled *r*'s, as Sievers has done.

If the journal lives, it will certainly contain much valuable matter. It is only to be feared that its rivalry will injure others already established, such as Kuhn's *Zeitschrift*.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Division of the Pacific. — This division includes those parts of California, Oregon, and Washington Territory the drainage of which flows to the Pacific Ocean. An exception is the Lewis Fork of the Columbia River, which rises within the limits of the Great Basin.

The work undertaken in this division is divided into two classes; viz., the investigation of the mining-industries, and the study of the volcanic rocks. As preliminary to the latter, topographic work has been carried on for two seasons in northern California. Some of the details of this work, in the vicinity of Mount Shasta, have already been published.

Examination of quicksilver deposits.— Mr. George F. Becker and his assistants have been engaged in an examination of the quicksilver deposits of California. During the season of 1883 Mr. Becker's personal attention has been devoted to investigations in the vicinity of Sulphur Bank. In August a trip was made to the North Fork of Cache Creek and to Lower Lake, the only localities in that section where fossiliferous strata occur. The latter part of August and early part of September were spent in this section in order to complete the map of the Clear-Lake region of California. Returning to Sulphur Bank, soundings of the lake were taken, and the final examinations of the mines made, after which the party returned to San Francisco to prepare for the winter's office-work.

In the New Idria district, topographic work in connection with Mr. Becker's work was carried on throughout the whole season by Mr. Hoffmann. The survey was made with the utmost care, and in great detail. Contour lines, eighty feet apart vertically, were run; and intermediate forty-foot contours were interpolated by means of slope-measurements in the steeper parts, and by running curves in the more level portions. The entire area surveyed includes twelve square miles, and the field-work for the map was completed early in 1884.

Geologic work. — Mr. Turner, under the direction of Mr. Becker, undertook an examination of the region in the vicinity of Knoxville, after a trip from Clear Lake to the latter point, during which, notes on the general geology of the line of travel were taken. His work was interfered with by sickness, which obliged him to enter the hospital at San Francisco for treatment. Later in the season, however, he returned to the field, and throughout January, 1884, was busy mapping the formations in the region about Knoxville.

L a b o r a t o r y w o r k. — Dr. Mellville, in the laboratory at San Francisco, has been busy with analyses of the minerals, rocks, and waters collected at Sulphur Bank, and with other analytic work in connection with the examinations of the quicksilver deposits. He and Mr. Becker have been investigating some of the chemical relations of quicksilver.

S t u d y o f t h e v o l c a n i c r o c k s. — Capt. C. E. Dutton has been placed in charge of the investigation and study of the volcanic rocks in this division, with Mr. J. S. Diller as assistant. Capt. Dutton, during most of the past season, was busy in the preparation of his memoir on the Hawaiian volcanoes, which will be completed in time for publication in the fourth annual report of the director. Owing to the as yet incomplete state of the topographic work (which is progressing satisfactorily under the charge of Mr. Gilbert Thompson) in northern California, the field geologic work has been confined mainly to preliminary reconnoissance work, which has been carried on by Mr. J. S. Diller. Mr. Diller and his assistants took the field at Red Bluff, Cal., early in July, and immediately began work in that vicinity. The plain east of Red Bluff is a volcanic conglomerate of andesitic basaltic fragments of tufa. This formation is apparently of great extent, and reaches to the eastward for twenty-five miles. Late in July the party left Red Bluff, after having made a trip of six days' duration to Lassen's Peak, and proceeded *viâ* Redding to Yreka. From this point the ascent of Mount Shasta was made, after which they went to Linkville, Ore., taking the valley of the Klamath River to cross the main platform of the Cascade Range. Mr. Diller spent some time in the region of Mount Scott and Crater Lake, the geological features of which he found especially interesting. A brief but careful examination was made of the valley which the Klamath River cuts across the Cascade Range, in order to ascertain the geologic structure of that mountain platform. Interesting studies were also made of the faults and dislocations on the eastern side of the range, near Klamath Lake. The work thus detailed kept the party busy during August; and during September the reconnoissance along the eastern side of the range was continued. Union Peak, Mount Thielson, Crescent and Summit lakes, and Diamond Peak were all visited. From the latter Mr. Diller proceeded to the group of volcanic cones known as the Three Sisters, where both Mr. Diller and his assistant, Mr. Hayden, met with the accident already noted, which obliged them to suspend work temporarily. Later on, however, the work was continued to the northward. An account of the return trip to Red Bluff, *viâ* the western side of the Cascade Range, has been already given in *Science*. The entire trip occupied a hundred and eleven days, and the distance travelled was twenty-five hundred miles. The work done will be of great service in the determination of many of the problems connected with the range, and will form an excellent basis for future field-work. Mr. Diller is of the opinion that a special study of Lassen's Peak, if made before the detailed examination of the Cascade Range is begun, will be of great service. He says, no other ancient volcano in the United States is known that has erupted such a variety of lavas, or placed them in so favorable a position for study of their succession, as has Lassen's Peak. The solfataric phenomena at 'Bumpass' Hill,' and other places in the vicinity of Lassen, are much more extensive than at any other point in the Cascade Range. The region is also readily accessible. To the northward and southward, there are good exposures of the rocks which form the foundation of the Cascade Range, whereas north of Mount Shasta the exposures of these rocks are limited.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Appalachian mountain-club, Boston.

March 12. — The following resolution was adopted by the club: holding in high esteem the geographical labors of the late Professor Arnold Guyot, be it resolved, that the Appalachian mountain club is impressed with the loss it is now called to sustain in the death of an honored and illustrious member, and that the club receives with gratitude that rich store of knowledge his researches have disclosed to those who seek the truths of nature among the Appalachian Mountains. —— A paper on mountain adventures by Mr. Alessandro di Placido, including a winter ascent of Fujiyama, Japan, and one by Dr. S. Kneeland on a visit to the crater of Vesuvius at night, in April, 1882, were read. —— Mr. C. H. Ames described the mountains around the Ktaadn iron-works in Maine. This group consists of thirty-one peaks, ranging in height from fifteen hundred to four thousand feet, the highest being White Cap. Mr. Ames exhibited a beaver-skin, moose-antlers, and a reindeer-head. —— Mr. W. M. Davis, representing the U. S. geological survey, explained the proposition which the survey has made to this state for the production of a map, and the following resolution was passed: resolved, that the Appalachian mountain club, in view of the great insufficiency of the existing maps of Massachusetts, recognizes, in the proposal recently made to the legislature by the U. S. geological survey, an opportunity to obtain a topographical map of the state which should not be lost, unless the legislature is prepared to inaugurate a more thorough and expensive plan.

Linnaean society, New York.

March 7. — The following officers were elected for the ensuing year: president, E. P. Bicknell; vice-president, Dr. A. K. Fisher; recording secretary, L. S. Foster; corresponding secretary and treasurer, N. T. Lawrence. —— Mr. E. P. Bicknell read the con-

tinuation of his paper, 'A study of the singing of our birds,' the first instalment of which has appeared in *The auk*. The portion of the paper read consisted of a consideration of the arrival, departure, and song periods, with their duration and lapse, of thirty-eight birds. His observations were made at Riverdale, N.Y. —— A paper was presented by Dr. C. Hart Merriam, giving a life-history of the woodchuck as he had found it in the Adirondack region; recording its change of abode from the meadows to the edges of the woods as the hibernating-time approached, its weak attempts at tree-climbing, its almost total abstinence from water, the rare exercise of its swimming-powers, its occasional evidence of carnivorous propensities; and closing with an extract from the laws of New Hampshire that offer a bounty of ten cents for each woodchuck destroyed in that state. Dr. E. A. Means stated that about two per cent of the Adirondack woodchucks were melanistic. —— Notes concerning a few early spring birds were given by Mr. N. T. Lawrence; and Mr. William Dutcher spoke of the recent capture of a fine female Archibuteo lagopus Sancti-Johannis in black plumage on Long Island. —— Mr. E. P. Bicknell mentioned the blooming of those early spring flowers, the skunk-cabbage and the golden saxifrage, at present at Riverdale, N.Y.

Cincinnati society of natural history.

March 4. — Mr. Charles Dury read a paper on North-American hares, with notes on the peculiarities and distribution of all the known species and varieties. He said that in Kansas and Colorado the common prairie hare, Lepus campestris, is commonly though erroneously called the jackass-rabbit. The true jack-rabbit, L. callotis, has a more southern range. A skin of a specimen shot by Mr. Dury in New Mexico was exhibited. He had measured tracks of this hare which were twelve feet apart. The flesh of L. callotis Mr. Dury found to be very coarse and unpalatable. Not so, however, that of the little sage hare, L. Nuttalli, which was very good, providing the animal be drawn immediately after being killed. If the intestines are allowed to remain for even half an hour, their contents give the flesh a sagy flavor. —— Prof. Joseph F. James read an abstract of notes on some plants of the vicinity of Cincinnati. He exhibited a series of specimens of Cardamine (Dentaria) laciniata and C. (Dentaria) multifida, which showed that the two species could not be separated, and should be included under one specific name. —— Mr. Davis L. James read a notice of Mr. Thomas W. Spurlock, a botanist of local reputation, — a sort of Tam Edwards, who followed botanical pursuits from a pure love of them, and who, by his liberal distribution of rare specimens, and by his simple and child-like love for flowers and plants, had laid collectors under many obligations, and made his memory dear to them.

Engineers' club, Philadelphia.

March 1. — Mr. William Ludlow described tests of the crushing-strength of ice which were made by him in order to learn approximately the strength required for an ice harbor of iron screw-piles, in mid-channel, at the head of Delaware Bay. Eighteen pieces were tried with government testing-machines at Frankford, Philadelphia, and at Fort Tompkins, Staten Island. The specimens were carefully prepared six-inch and twelve-inch cubes, and roughly cut slabs about three inches thick, of different qualities and from different localities. For pure Kennebec ice the lowest strength obtained was three hundred and twenty-seven pounds, and the highest a thousand pounds, per square inch. For inferior qualities the strengths varied from two hundred and thirty-five to nine hundred and seventeen pounds. The higher results were obtained generally when the air temperature in the testing-room was from 29° to 36° F., as against 55° to 68° F. for the lower results. The pieces generally compressed half an inch to an inch before crushing. —— The secretary exhibited for Mr. C. A. Ashburner a set of blue prints of some yet unpublished details of the Chicago cable railways. —— The secretary presented a note, by Prof. W. S. Chaplin, upon a prevalent error in data given for determining the true meridian, by observing the instant at which Polaris and Alioth come into the same vertical, and then following Polaris for a *certain time*, at the expiration of which it is said to be on the meridian. He gives as the true time the following: latitude 40°, 25 m. 36 s.; latitude 50°, 25 m. 24 s.; latitude 60°, 25 m. 5 s.; latitude 70°, 24 m. 29 s. —— Mr. C. J. Quetil exhibited models of the wire truss recently described by him. —— Professor Mansfield Merriman presented a statement of the progress of the triangulation carried on in Pennsylvania by the U. S. coast and geodetic survey.

Academy of natural sciences, Philadelphia.

Feb. 28. — Dr. Joseph Leidy directed attention to some parasitic worms, which included specimens of supposed leeches from the mouth of the Florida alligator. Herodotus states that the crocodile of the Nile had the inside of his mouth almost beset with leeches. The truth of this assertion has been confirmed by modern zoölogists, the species being the Bdella nilotica. The Florida specimens are, however, not leeches, but pertain to a species of Distoma or fluke, apparently not previously described, for which the name Distoma oricola was proposed. Of several Filariae, or thread-worms exhibited, two, a female and a male, belong to the species Filaria horrida. The former is twenty-eight, and the latter eleven, inches long. They were obtained from the thorax of the American ostrich. Other specimens were found in the abdomen of the marsh-owl. Two species of thread-worm have been previously observed in the bodies of owls, to neither of which the specimens under examination appear to belong. They so closely accord, however, with the descriptions of another species, Filaria labiata, infesting the black stork of Europe and northern Africa, that, notwithstanding the remote relationship in the host, the speaker believed them to belong to that species. —— Dr. N. A. Randolph spoke of the changes which occur in milk during boiling. Although but little difference can be detected by the unaided senses between raw and boiled milk, it was well

known, that, during the process of boiling, certain gases are given off; and the behavior of the fluid afterwards, under certain reagents, is different from that in its original state. If rennet be added to boiled milk at the temperature of the body, no change occurs for some hours; while, if added to raw milk, coagulation takes place rapidly. If diluted acid be added to boiled milk, it produces immediate coagulation; but, if mixed with the raw fluid, coagulation takes place much less rapidly. If alkali be added to the former, cream arises with rapidity and completeness, while no marked change occurs when it is added to the latter. Observations made, of forty-six specimens of gastric contents obtained from six men fed on milk, established the fact that unboiled milk had slightly the advantage as a nutrient, being somewhat more digestible than when boiled. Peptone was found to be present at all stages of digestion. His observations on the effect of rennet confirmed those of Schreiner, published some time ago in Munich. —— A communication was read from Miss S. G. Foulke on the structure and habits of Manayunkia speciosa, the fresh-water worm recently described by Professor Leidy. Miss Foulke has had an opportunity of studying mature specimens, and has consequently been able to make important additions to Dr. Leidy's account of the species, which was based on young specimens.

NOTES AND NEWS.

A GENERAL meeting of the American forestry congress will be held at Washington, D.C., on May 7. Time and place have been chosen contrary to precedent, in order to find an opportunity of calling attention to the society's active work, and impressing upon Congress, then assembled, the needs and requirements of forestry in this country. It is therefore desirable that such meeting should be well attended; and no individual efforts should be spared by the members and friends of this association to make the same particularly interesting and effective. The following subjects have been selected as leading topics of discussion, referees having been appointed to prepare papers in regard to them: Value of American timber-lands; Management of timber-lands and timber in Canada, and legislation thereon; Value and management of government timber-lands; Best method of planting trees on unoccupied government lands; Influence of forests on climate and health; Insects injurious to trees, causes and dangers of their excessive multiplication, and how to meet them in their wholesale ravages; Growing forests from seed by farmers; Preservation of forests on head waters of streams; Planting of trees by railroad companies; Irrigation in connection with tree-planting; Experiment-stations and forest-schools; How can we best promote the interest in, and knowledge of, forestry among all classes of this country?

— The yearly meeting of the Russian geographical society was, as usual, largely taken up by the report of the secretary about the yearly work. Nothing of special interest, not yet known, was included. In the yearly award of the medals which followed, the greatest gift of the society, the Constantine medal, was given to N. A. Sewertzow, the celebrated zoölogist and explorer of central Asia, for his lifelong work. The great gold medals of the sections of ethnography and statistics were not awarded this time. The Lütke medal was given to H. A. Wild for meteorological works. Four gold medals and a considerable number of silver and bronze ones were also awarded.

At the February meeting of the society a communication was received from Bukharow, Russian consul at Hammerfest, Norway, about his extensive travels in the Lapland peninsula in the fall of 1883. The fourth number of the society's *Izviestiya* has been issued. It contains, besides matter mentioned here, Konshin's account of the Kara-Kum sands in central Asia, and Vasenew's travels into western Mongolia.

— At a meeting of railroad engineers in Moscow in December, 1883, the establishment of meteorological stations at the railroad-stations, and of weather-telegrams sent by the railway-wires to Moscow, so as to be able to get information about the state of the weather, and predictions of events of interest to railroads (as snow-storms, heavy rains, and sudden thaws), was proposed. A meeting of the railroad boards, held soon after, agreed to this proposal; and so it is to be hoped Russia may soon have a system of observations by properly paid and controlled men, instead of relying entirely, as now, on unpaid and voluntary observers.

— A call has been issued for a meeting of inventors and persons interested in the perpetuation of the present system of U. S. patent-laws, to be held at Music Hall, Cincinnati, March 25, 26, and 27. The call is signed by gentlemen from twenty states, and delegates are expected from thirty-two states. Arrangements are being perfected for a probable attendance of three thousand.

The first object of this meeting is to effect a permanent organization for the purpose of protecting the rights of inventors and patentees. Over two hundred and fifty thousand patents have been issued by the United States, from which it is clear that very large interests are at stake in any changes of the patent-laws such as are now pending before Congress. Twenty-eight bills have been introduced in the present Congress, which interfere more or less directly with patents or their owners, and diminish in one way or another the protection afforded to inventors. One bill provides that no damages can be recovered for infringements prior to written notice served on the infringed by the patentee, thus rewarding the secret manufacture of patented articles. Another bill is to prevent the recovery of damages in cases where the amount involved is less than twenty dollars; and another bill fixes this amount at fifty dollars.

— On the 11th of February died John Hutton Balfour, for many years professor of botany in the University of Edinburgh, director of the Royal botanic garden, and Queen's botanist for Scotland. He was born in that city on the 15th of September, 1808, and

had therefore attained a good old age. About four years ago, in failing health, he resigned his official positions, but afterwards recovered his vigor, so that he might have been expected to see his university fairly entered upon its fourth century. The end of this excellent man came suddenly, — we believe, in the same week in which his son, Isaac Bayley Balfour, was elected professor of botany at Oxford. The elder Balfour was eminent only as a teacher of botany, in which he had great success, and in the development and administration of the admirable garden and arboretum of the Scottish capital.

— A "general geologic map of the area explored and mapped by Dr. F. V. Hayden, and the surveys under his charge, 1869 to 1880," forms No. 11. of the series accompanying the twelfth and final report of the geological survey of the territories. This map was not mentioned in our notice of the report (*Science*, No. 51), as it was omitted in the earlier distributed volumes; but it is of especial value in presenting a general review, that is nowhere given in the reports, of what has been accomplished by Dr. Hayden's parties. It includes all of Colorado and Wyoming, the greater part of Montana, and half of Dakota and Nebraska. It has unfortunately no topographic shading; and there is no distinction made in the coloring of those parts that have been examined with satisfactory detail, and others where information is derived from reconnoissance, or even from hearsay. Still, the more notable features of the region are well shown, — the broad monotony of the plains, the inconstant variety of the irregular mountain uplifts, the long-continued paleozoic and mesozoic conformity, and the absence or insignificant representation of the Devonian in the Rocky Mountains proper, and the unconformable overlap of the tertiary. Of more local peculiarity, there may be mentioned the isolated uplift of the Black Hills, here well shown in its relation to the ranges farther west; the abrupt change from a north and south to an east and west trend in the Laramie range; the appearance of narrow and parallel Great Basin ranges at the western margin of Wyoming; and the crescentic form of the Big Horn range. Concerning this last and the more northern part of the map, further exploration may require considerable changes.

— Mr. Paul Bert read to the Paris academy, at a recent meeting, the latest results of his researches into the effects of anaesthetics. He believes that the use of chloroform in surgical cases, where the patient suffers from weakness of the heart, may be made comparatively, if not entirely, safe. Mr. Bert is of opinion that the quantity of an anaesthetic is less important to observe than the tension of the vapor inhaled, and the proportion of air with which it is mixed. He has constructed an apparatus with which he administers a proportion of eight grams of chloroform to a hundred litres of air. Experiments which he has made with this have shown, that not only is a saving of chloroform effected, but the danger is considerably lessened. The pulse of the patient inhaling the mixture is calm, and the temperature of the body is not sensibly lowered; while in only four cases out of twenty-two was the slightest appearance of nausea produced.

To this proposition of Bert's, Gosselin objected that the use of a cumbersome piece of apparatus, in place of the convenient sponge or handkerchief, ought to be considered; and that by Bert's method a uniform amount of chloroform must needs be administered to all patients, regardless of their susceptibility to its effects.

Bert rejoined, that with the sponge there was great danger of exceeding the safe tension of the vapor. His experiments with dogs showed, that, with six grams of chloroform to a hundred litres of air, a dog could be rendered insensible; with ten grams, the insensibility comes on in a few minutes, and can be allowed to continue for an hour and a half with safety; while, with twenty-four grams, the dog was dead in forty-five minutes.

— The petroleum industry of Baku still continues, to attract attention. Messrs. Hobel, whose work there has been of such importance to the development of the trade, have published a pamphlet on the capabilities of the province, and the commerce of the Black Sea; while a book is announced in the literary journals, dealing with the working of petroleum since classical times. The title is 'Petrolia;' and it is by Mr. Charles Marvin, of Khiva fame.

— The *Centralblatt für textil industrie* recently published an article on the increase in manufacturing industry in Livonia, Esthonia, Courland, and the Polish provinces of Russia. The first three provinces contain 1,329 factories, the annual production of which now represents a total value of more than £12,000,000, this sum being nearly double the amount for 1873. In Courland the main industry is the distillation of spirits, which in 1882 attained a value of nearly £1,000,000. The development of Polish industry took place, for the most part, during the years 1877–80. In the year 1881 Poland contained 19,000 factories, which produced wares of the total value of about £30,000,000. The greatest progress has been in the textile industries. One factor in the industrial activity of Poland has been the steady demand for yarn from factories in the interior of Russia. The cotton industry is the most important: in 1881 it employed about 20,000 work-people, its out-turn representing a value of £5,000,000. Next comes the woollen industry, with 15,000 work-people, and a yearly production of £3,500,000 in value. In the linen branch 10,000 work-people are engaged, and the production represents about £1,000,000 per annum. The raw material is, for the most part, obtained from the interior of Russia, only a small quantity being imported. Moscow, Charkoff, and St. Petersburg are the principal markets.

— The *Engineer* states that the world's average product of sulphur is about 280,000 tons, of an average value of 109.20 lire per ton = 30,793,000 lire, or over £1,200,000 sterling. Of this total, Sicily produces 242,000 tons. There is an export duty of 11 lire per ton on sulphur, and the average export is 216,000 tons. The Sicilian sulphur is mostly exported raw,

as it comes from the kilns. It is of seven qualities, the values varying from 101 to 115 lire per ton. Except in the better-worked 'solfare,' the separation of the sulphur from the earths in which it is contained is still conducted in Sicily by means of kilns (calcuroni), which do not require any additional fuel, but which entail the consumption and loss of about one-third of the sulphur itself. About 18,000 hands are employed in the Sicilian 'solfare,' of whom about 14,000 work in the interior of the mines, including those employed in the transport of the ore to the surface. The sulphur in many mines is still carried to the surface on the backs of boys called 'carusi,' of whom there are about 3,500.

— Prof. F. H. Snow writes to the *Topeka daily capital* as follows: —

The climate of eastern Kansas is not the climate of western Kansas. Any discussion of this subject will be entirely inadequate which fails to recognize the fact that Kansas is meteorologically divided into two distinct regions, separated from each other by an intermediate area, whose climate exhibits a gradual transition between the eastern and the western sections. The inclusion of two such widely differing regions in one civil commonwealth has its disadvantages as well as its advantages. The striking adaptability of western Kansas to sustain the immense cattle interests of that section adds an important element of prosperity to the state; but the fact that thousands of new-comers, from ignorance of the climate, have attempted to introduce ordinary agricultural operations upon the so-called 'plains,' and have disastrously failed in the attempt, has placed an undeserved stigma upon the good name of Kansas in many far distant communities, and has undoubtedly somewhat retarded immigration during the past few years. It is time for the general recognition of the fact, that, except in the exceedingly limited area where irrigation is possible, the western third of Kansas is beyond the limit of successful agriculture. Yet this portion of Kansas, upon the basis of one individual to each ten acres, has the capacity to continuously sustain an aggregate of nearly two million head of cattle. The last biennal report of the State board of agriculture represents the total number of cattle in the entire state as less than one and a half millions, which is considerably below the number which might be supported by the western third of the state alone.

The average direction of the winds in eastern Kansas is from the south-west. The average velocity of the wind at Lawrence is a little more than fifteen and a half miles an hour. This is sufficiently high to assist materially the proper ventilation of our houses and our clothing, but does not justify the common expression in other parts of the country, that the Kansan lives in a continual gale. For the sake of comparison, it may be mentioned that the average hourly velocity of the wind in Philadelphia is eleven, at Toronto nine miles, and at Liverpool thirteen miles. The greatest velocity recorded at Lawrence was at the rate of eighty miles per hour, from 3.35 to 3.45 A.M., April 18, 1880. The average annual distance travelled by the wind at Lawrence is a little more than a hundred and thirty-eight thousand miles. March and April are the two windiest months, the velocity rising to nearly twenty miles an hour. July and August are the two calmest months, the rate subsiding to less than twelve miles an hour.

— The *Canadian naturalist*, which was discontinued last June, has re-appeared as the *Canadian record of natural history and geology*, published by the natural history society of Montreal. The former journal was published for the society by Messrs. Dawson Brothers. We regret the unnecessary change of title, when the scope of the journal is precisely the same as before, and it remains the organ of the same society.

— The belief of the Hawaiians, that the Achatinellae emit musical sounds, is an old one; and these pretty little mollusks were sometimes called 'singing-snails.' The Rev. H. G. Barnacle, M.A., of the Transit of Venus expedition in 1874, heard the music, which he compares to the sound of many aeolian harps. Hitherto the native story has not found credence among conchologists; but this gentleman succeeded in determining that the sound was due to the friction of the shells upon the bark of the trees, over which they are dragged by their inhabitants. As most of the species are arboreal, and they exist in millions, it is conceivable that the sound should be distinctly audible; yet that it should be in any way musical is singular.

— Miss Fannie M. Hele has recently observed the effect of food on a lemon-colored variety of Helix aspersa. A diet of lettuce reduced them to a dirty-brown yellow; and the more lettuce given to them, the darker and dingier the color of the shell became. A reversed specimen was bred from, in the hope of securing additional specimens of this rare variety; but to no purpose: the eggs, when hatched, produced only normal individuals.

— During the past year, four new additions were made to the group of small planets between Mars and Jupiter, making the number two hundred and thirty-five in all. No. 232, named Russia, was discovered the 31st of January, 1883, by Palisa, at Vienna: its magnitude is the twelfth, and the elements of its orbit exhibit no peculiarities. No. 233, not yet named, was discovered by Borelly, at Marseilles: its magnitude is the eleventh, and the elements of its orbit are as yet undetermined. No. 234, named Barbara, was discovered the 12th of August, 1883, by Peters, at Clinton: its magnitude is the ninth, and the elements of its orbit exhibit no peculiarities. No. 235, named Carolina, was discovered the 21st of November, 1883, by Palisa, at Vienna: its magnitude is the twelfth, and the elements of its orbit are as yet undetermined. The twelve small planets immediately preceding the above have received names as follows: —

220, Stephania.	224, Oceana.	228, Agathe.
221, Eos.	225, Henrietta.	229, Adelinda.
222, Lucia.	226, Weringia.	230, Athamantis.
223, Rosa.	227, Philosophia.	231, Vindobona.

SCIENCE.

FRIDAY, MARCH 28, 1884.

COMMENT AND CRITICISM.

The University of Edinburgh is making arrangements to celebrate, on the seventeenth day of April next, the three hundredth anniversary of its foundation, by an academic assembly, to which the chief institutions of learning throughout the world are invited. Several American colleges are to be represented. With reference to this tercentenary, Sir Alexander Grant, the principal, has just published two stout octavo volumes, in which 'The story of the University of Edinburgh' is elaborately told. The volumes are rich in illustrations of all the concurrent influences which have given renown to the youngest and strongest of the Scotch institutions. The rise of each important department of instruction is told, and the lives of all the more distinguished professors are briefly given.

Among the natural sciences, medicine has been the one most encouraged in Edinburgh, although it must be remembered that much of the medical reputation of the city is due to the peculiar arrangements by which medical men not connected with the university give instruction, and prepare young men for medical graduation. 'Extra-mural' instruction is the term employed. Nevertheless, the roll of university professors includes the name of Charles Bell, of whom the story is told, that, when he visited the class-room of Roux in Paris, Roux dismissed the class, saying, 'Sufficient, gentlemen: you have seen Charles Bell.' Another university professor was Sir James Y. Simpson, whose bold introduction of chloroform as an anaesthetic is world-renowned. When a Scotchman was presented at the court of Denmark, the king said, 'You come from Edinburgh? Ah! Sir Simpson was of Edinburgh.' Simpson himself said he was more interested in having delivered a woman without pain than in having been made physician to the queen. At an earlier date the fame of William Cullen was wide-spread. Among the teachers of non-medical sciences, the names of Black, John Playfair, Robert Jameson, David Brewster, Edward Forbes, James D. Forbes, and Wyville Thomson are those which come first to mind; while in mental and moral science the Scotch philosophers, Dugald Stewart, Thomas Brown, and Sir William Hamilton, are not likely to be forgotten. It sounds strange enough in these days to read that Thomas Carlyle thought himself ill-used because he could not get the appointment of practical astronomy and astronomer royal in 1834. Instead came Thomas Henderson, who won renown as 'the first discoverer of our distance from a fixed star.' We do not name any of the living professors, and we pass without mention many famous men who are gone; but what we have said suggests the doctrine, which cannot too often be repeated in this country, that the standing of a university depends upon illustrious teachers. The world of scholars, no longer united under the sovereignty of the pope, but loyal to the higher sovereignty of truth, will with one accord extend its congratulations to the great modern foundation of Scotch learning, and will rejoice that in its three-hundredth year it has reached its greatest numerical expansion, with increasing devotion to all that is noble in science and education.

The reports of the U. S. signal-office show that there were at Cincinnati, during last February, four clear days, three fair days, one cloudy, and *twenty-one* on which rain or snow fell; and that the total precipitation was 8.87 inches. The following figures give the precipitation in inches during February of each year since 1870: 1871, 2.27; 1872, 1.67; 1873, 3.76; 1874, 5.91; 1875, 1.83; 1876, 2.92;

1877, .67; 1878, 2.33; 1879, 2.22; 1880, 4.50; 1881, 4.95; 1882, 7.04; 1883, 8.22; 1884, 8.87. We hazard nothing in asserting, that it does not lie within human ability to arrest such mighty storms as occurred in 1883 and 1884: and it may fairly be questioned whether the ingenuity of man can devise means to prevent the wide-spread and destructive floods which must follow such a volume of water as then fell; whether any extension of forests, or system of catch-basins or reservoirs, could possibly retain or mitigate to any considerable extent such general and overwhelming floods. A system of artificial lakes might indeed be at such times a serious element of danger; for, if one of them should break its restraining banks, its accumulated waters would be likely to carry away others, and then the waters, suddenly let loose, would do damage of which we have had a few frightful examples on a small scale.

THE demands of progressive agriculture for a more substantial scientific basis are just now beginning to find definite expression in the Dominion of Canada. From the known attitude of certain members of the government, from the recent examination of experts before a special House committee at Ottawa, and from the general expressions of those who have a direct interest in the question, it is apparent that a keen sense of the utility of experiment-stations is now developing a movement, which, it is to be hoped, will secure for the Dominion one or more much-needed stations, founded upon the European idea of their utility from a scientific stand-point, and from that of the practical application of acquired results.

THIS season promises to be one of unusual activity in the observation and study of tornadoes. In response to an invitation from the signal-service, a considerable number of tornado reporters is secured; and the first fruit of their labors has just appeared with most praiseworthy promptness in the form of a set of four preliminary charts illustrating the recent numerous and destructive tornadoes in the southern states on Feb. 19. Further investigation is needed before a final account of these terrible storms is prepared; but it is shown by these charts, that over fifty tracks of tornado-action have been reported for Feb. 19, between seven in the morning and midnight, all occurring within a cyclonic area, and from three to seven hundred miles south-south-east of the centre of low pressure. As the broad cyclone moved forward, its centre passing from Illinois to Lake Huron, the tornado district on its southern edge had a similar advance across the southern states. The cyclone was peculiar in showing a long, trough-like barometric depression, and in presenting notably strong contrasts of temperature between its south-eastern and north-western sides. The tornadoes were all developed within the district occupied by warm southerly winds, somewhat in advance of the cold north-westerly winds; but they moved, without exception, in a north-easterly direction. Their destructive action was most severe in eastern Alabama, northern Georgia, and centrally across the Carolinas. Rough estimates place the value of property destroyed at between three and four million dollars; the loss of life, at about one thousand; the wounded, at more than double that number; while the homeless and destitute people are reported to count from fifteen to twenty thousand, many of whom are in a starving condition. About ten thousand buildings are said to be destroyed, and domestic animals were killed in great numbers. It hardly need be urged, that the possibility of giving some warning of immediate danger before such storms warrants the fullest and most careful investigation of all their attendant conditions.

In preparation for this work, the 'tornado circulars,' issued by the signal-service to promote the accumulation of record and statistics of these destructive storms, have now reached the number of twenty. The most considerable of the later ones is No. 16, which contains, in all, two hundred and three questions or directions designed to aid in the precise description of tornadoes and the conditions of their formation: these are arranged under several head-

ings, addressed to observers on the immediate track, or more than ten miles from it; and, if carefully read, they will serve as good training for those who desire to take part in the investigation of these most disastrous upsettings of the atmosphere. Circular 18 relates to observations to be made 'concerning the presence of electricity in tornadoes,' and asks thirty-two questions to this end. It is to be hoped that all persons living in the tornado districts of the country, and desiring to take part in the work as volunteer observers, will apply to the chief signal-officer for circulars of instructions.

It is worth mentioning, that the single waterspout recorded in the supplement to the pilot-chart of the North Atlantic for March occurred on Feb. 19, eighty miles east of Charleston, where it struck the schooner Three sisters, "carrying away main gaff, mainsail and foresail, and flattening in the after-hatches." This is evidently connected with the group of tornadoes above described.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible.*

Law connecting physical constants.

IT may be of interest to some of your readers to know how the two formulae published in the advertising columns of Science, No. 54, can be derived from the magnetic theory of molecular cohesion.

The work necessary to separate completely the particles of a body occupying the unit of volume can easily be calculated if we know the original attraction between every two particles, and its rate of change during expansion. For small magnetized spheres, this work is equal to the resultant attraction across the unit of surface. The latter, moreover, is necessarily equal to the pressure which the particles keep up by their incessant motion; which, again, is shown, by a well-known dynamical theorem, to be equal to the continued product of the coefficients of expansion and of resilience and the absolute temperature. This product is therefore finally the mechanical equivalent of the internal latent heat of the unit of volume of a liquid.

The theory does not apply to such liquids as water, in which, at low temperatures, a molecular re-arrangement is evidently going on; but in general, the higher the temperature, the more closely is the law fulfilled. The grouping of the atoms, and their vibration within the molecule, recently treated by Professor Eddy of Cincinnati, produce in the most unfavorable cases a variation of about thirty per cent from the theory: nevertheless, the general agreement is too great to attribute to chance, and becomes almost perfect when the causes alluded to are considered. The average value of the latent heat for ordinary liquids may be shown to be about 1.2 times greater than for simple substances.

The molecules of all liquids appear to be very close together, notwithstanding the common prejudice that they are far apart; and, taking into account the comparative shortness of their free path, the coefficients alluded to may be obtained approximately by processes of ordinary differentiation, while their rate of change as the temperature increases can be determined as accurately as by actual observation.

The latent heat is found to vary inversely, the coefficient of expansion almost directly, as the free path of the molecule; and their continued product with the molecular weight is therefore nearly, but not quite, constant. The average value is about eight and a half; and any slight variations from this average are accounted for by the complete formula.

With these hints, and remembering that the inductive attraction between two small magnets varies as the seventh power of the distance inversely, while their normal attraction is inversely as the fourth, any mathematician familiar with the principles of physics may verify the laws already enunciated, and deduce others of equal importance in the same way.

The difference, for instance, between the specific heats in the state of liquid and vapor, is evidently the derivative of any true expression for the latent heat; and the critical temperature is found by supposing the latent heat equal to zero. The relations between all these quantities are represented with a remarkable degree of approximation.

The magnetic theory of cohesion promises to be, in molecular physics, what the law of universal gravitation has proved to be in astronomy. While carrying on the development as rapidly as possible myself, I would urge others, independently, to do the same, in the belief that this theory affords a most magnificent field, both for work and for discovery.

HAROLD WHITING.

Cambridge, March 17.

Relics in Ventura county, Cal.

Rincon Creek, fourteen miles west of San Buenaventura, is the dividing-line between Ventura and Santa Barbara counties. Where this creek flows into the ocean, at least a hundred acres are covered with shells, bones, fish-scales, and other kitchen *débris* of the Indians, who have lived here from time immemorial. The creek, which is fed by mountain springs, afforded good water; the ocean yielded fish and mollusks; while the foot-hills and mountains furnished wild game. A large variety of mollusks are still found at this point, and the shell-heaps indicate their great abundance in past time. Edible clams especially abounded; as Pachydesma crassatelloides, Tapes staminea, T. diversa, also Mytilus californianus.

Rincon Point was doubtless long a favorite resort for the early race that inhabited this coast. In one spot I found human bones, a few years since, which were in a semi-fossil state. They had been buried on the brow of a high bluff overlooking the sea, and were about four feet below the surface. One skull, that of an aged person, was perforated at the apex. The perforation seems to have been made by a sharp instrument, and some time before death, but for what purpose it is difficult to say. In another spot on the mesa, and three hundred yards from the ocean, occurred a burial-place in which the skeletons were reduced to an impalpable dust. In this dry soil and climate it must have required centuries for them to decay. In this place I found many 'sinkers' from three to twelve inches long, carved from sandstone, limestone, etc. They were from three-fourths of an

inch to an inch and a half in diameter in the middle, gradually sloping toward each end. There were also tubes of serpentine six or eight inches long, large chert knives, spear-points, and other things, all buried about four feet deep. Between this spot and the ocean was another burial-place, where, on the side of a declivity, many skeletons were found but eighteen inches to two feet below the surface, mingled with broken sandstone mortars and pestles, spear-points, arrow-heads, etc.

On the east side of the creek, between a high precipitous bluff and the ocean, is a three-cornered tract containing about ten acres, which is the site of an old rancheria or village. In the midst of this old town site I found a burial-place that indicated a somewhat more recent race than the first two mentioned. Here I exhumed a hundred or more skeletons, and at least a ton of relics: consisting of mortars and pestles of sandstone, ollas and tortilla stones of crystallized talc, pipes and bowls of serpentine, spear-points and arrow-heads of chert; also beads and 'charms,' and innumerable shell ornaments.

Last month I again visited this place, and exhumed a few more relics. In a spot about four by eight feet, and in the shape of a parallelogram, I found fifteen skeletons. With one of these were three tubes about three inches in length. In shape they were similar to the 'sinkers' already described, but with raised beads in the middle and at each end. These and some round beads were manufactured from serpentine. Beside the specimens mentioned, were many small shell disks made from Olivella biplicata. An arrow-head was found with another skeleton. About three feet from the excavation described, I found three more skeletons, one of which was that of a child; and with it occurred two stone tubes similar to those above mentioned, also three round beads about one inch in diameter. The beads and tubes were of serpentine, containing seams of chrysolite, and were finely polished. With another skeleton, were five arrow-heads finely chipped from chert. One was a beautiful specimen with serrated edges, and a portion of the asphaltum with which it was fastened into the arrow still remained. With another, occurred several ornaments manufactured from Lucapina crenulata, and also an arrow-head. In a spot occupying less than fifteen feet in diameter I exhumed forty skeletons, piled one upon another. They were buried face downward, and could be counted only by the skulls.

STEPHEN BOWERS.

San Buenaventura, Cal.

The spirifers of the upper Devonian.

In the prefatory letter of the Report of progress, G. 7, of the Second geological survey of Pennsylvania, certain statements are made respecting the association and order of some of the fossil species of the Devonian rocks of New York, calling for comment.

It is stated on p. xx., in regard to Spirifera disjuncta, S. mesocostalis, and S. mesostrialis, that, "outside of Pennsylvania, these three species have been found, (1) never in any but Chemung rocks; (2) confined each to its own horizon; and (3) always in a fixed order from above downwards;" and, on p. xxi., that "Professor Hall has never seen any two of the three species co-existing in the same stratum; . . . that he cannot comprehend how S. dj. and S. ms. should be found together" (as they are reported to occur on p. 65 of the report).

Again (p. xxii.) it is stated that "Orthis tulliensis, in bed 41, § 13, p. 70, has certainly never before been seen in the Chemung 200′ above the Genesee (i.e., 300′ above the Tully limestone), nor in company of S. mesocostalis."

The report of species in such 'uncanonical' positions in the strata is made a reason for concluding (p. xxvi.) that "the startling fossil species of this report will therefore be regarded by the palaeontological reader as only *provisionally verified.*"

While the statements cited may express the general rule as to the occurrence of species in New-York state, there are specimens in Cornell university museum which do not bear out the statements.

In the first place, the two species S. mesostrialis and S. mesocostalis are found associated in the same stratum at Ithaca, N.Y., both in the mesostrialis zone and in the mesocostalis zone. Several instances can be shown where they occur on the same slab.

From a higher horizon in New-York state, and from several localities, either of these species may be found associated with S. disjuncta; and I have obtained each of the three species from the original Chemung locality at Chemung Narrows.

In the museum collection, is a small slab from that locality, containing beautiful representatives of S. disjuncta and S. mesostrialis; the latter preserving 'the fine radiate striae, with delicate concentric cross-lines' all over the surface of the shell, and with 'the broad median fold without a depression,' which are described as distinctive characters of the species (Pal. N.Y., vol. 4, p. 243).

The other specimen, only a couple of inches distant, has the characteristic plications on the median fold, and, with a surface equally well preserved, shows not the least trace of radiate or concentric striae, unmistakably indicating S. disjuncta.

From the same locality, though not on this individual slab, are specimens of both varieties of the so-called S. mesocostalis, — the large, coarse form with angular plications and reduplicated fold, and the more finely plicated form with prolonged hinge-line, which is more characteristic of a lower horizon.

These higher representatives of S. mesocostalis are, however, generally distinguished from the earlier representatives by a well-developed median septum in the ventral valve, — a character of which only a trace is seen in specimens from the Ithaca beds, reminding us of the genus Spiriferina. The punctate shell-structure of that genus has not, however, been detected in any specimens thus far examined.

In regard to Orthis tulliensis, it may be said that the common Orthis, occurring at the base of the Ithaca fauna, within a few hundred feet of the Genesee shale (less than 500), at its first appearance resembles O. tulliensis in form and general characters; though for distinction it may be appropriate to call it a variety of O. impressa, since a little higher, and in the same fauna, the typical O. impressa appears in abundance.

Still, there are specimens in the collection from the lowest zone which it would be difficult for any one to distinguish, by macroscopic or microscopic characters, from O. tulliensis, occurring, as they do, in a calcareous stratum.

I have no single slab containing this form with S. mesocostalis, but the latter is found both above and below the stratum containing the Orthis.

The record of an O. tulliensis at 200 feet above the Genesee shale in Pennsylvania seems, therefore, indicative of a careful identification of the species upon morphologic characters alone, without prejudice as to its supposed horizon or range.

In regard to the identification of these upper Devonian faunas of Columbia county, Penn., it may be said, that in the association of species, and the

relative order of the sub-faunas, the record agrees, in general, with that of the series exposed along the same meridian, farther north, in New-York state. The principal difference which strikes one familiar with the New-York section is the appearance of S. disjuncta and O. Tioga lower down in the faunas in the southern sections.

But although heretofore S. disjuncta has been met with in America only in the middle and upper parts of the upper Devonian, in Devonshire we find it reported from the middle Devonian, with corals and trilobites in abundance; and in northern Europe it begins at least as early as the base of the upper Devonian.

While it is beyond doubt that even in New-York state the three spirifers mentioned appear mingled at various zones in the upper Devonian, we do not question the fact that the periods of abundance for each species are in separate zones, and assume a regular sequence relative to each other.

HENRY S. WILLIAMS.

Cornell university.

The use of the method of limits in mathematical teaching.

Rice and Johnson's 'Method of rates' is especially to be commended for the scholarly manner in which they developed the subject; but there is the same difficulty in the fundamental conception as in the infinitesimal method. One may assume to understand an expression with which he is familiar until closely questioned. A student learns to repeat with ease, 'Velocity is rate of motion,' and thinks he understands it; but I have had many such ask, 'In a mathematically perfect engine, does the piston stop at the end of the stroke?' 'Does it remain at rest at any time?' 'How can it reverse its motion, if it does not stop?' 'How can it cease going in one direction, and move in the opposite direction, without stopping between the two motions?' These are critical questions, lying at the very foundation of all change of motion. Does change in the rate of motion take place *at* an instant, or *during* an instant?

The method of limits leads the mind towards a result the conclusions of which it is impossible to escape: hence, as a system of philosophy, it retains its strong hold. DE VOLSON WOOD.

Hoboken, March 16.

Ropes of ice.

On Saturday, March 8, while traversing several counties of southern Ohio by railroad, I observed an illustration of the viscosity of ice, that seems deserving of mention.

For a number of hours, rain had been falling, much of it freezing as it fell; but through the day the temperature rose slightly, remaining, however, close to the freezing-point. All exposed objects were coated with ice. In particular, telegraph-wires and the strands of wire fences were heavily loaded. In the afternoon the ice broke loose from the wires at innumerable points, hanging from them in depending curves, the fixed points of which were sometimes as much as six or eight feet apart, and the lowest points of the curves from two to twelve inches below the wires. Occasionally the curves would break, and the ends of the ice rope, two or three feet in length, would project downwards from the wires at an angle of forty-five degrees or more.

The best examples were passed without opportunity to make examination, but all of the facts were illustrated at the stations where the train stopped.

E. O.

Illusive memory.

I merely intended, in my letter of March 7, to present two of the most prevalent theories which have been advanced for these illusions. The 'race memory' theory, kindly brought out by W. B. T., should perhaps have been mentioned, as well as the theory of Lewes and Ribot, that these deceptions arise from the retrojection or false location of a *present* mental image as a recollection. The inheritance of the actual *cerebral impressions* of a former generation rests upon no scientific basis. We do inherit the brain structure, and, in so far as brain functions are dependent upon structure, we may be said to inherit certain functional disposition and powers; but this structure, and the impressions made upon it by sense-perception, are essentially different facts.

The correspondence invited should be addressed to Princeton, *N.J.*, instead of Princeton, N.Y., as as wrongly given in *Science*, No. 57.

HENRY F. OSBORN.

Princeton, N.J., March 21.

Ripple-marks.

Professor Wooster's note in No. 57, on ripple-marked limestones in Kansas, recalls an observation of my own in Utah. In the south part of that territory the Jurassic formation includes a sectile limestone fifteen to twenty-five feet in thickness, containing remains of Camptonectes and Pentacrinus. Some of the surfaces of the layers exhibit coarse ripple-marks, the wave-lengths ranging from six inches to one foot. The associated fossils cannot be regarded in this case as indicative of quiet conditions, for in neighboring districts the same forms are found in argillaceous sandstones. In the sandstones the shells and crinoid segments exhibit wear from rolling, but in the limestone their angles are unimpaired. While, however, there is no evidence in the limestone of violence, there is evidence of motion. The crinoids have not been found entire, and all their segments are usually detached. Moreover, the structure of some of the limestone layers is oölitic.

I conceive that the association of ripple-marks with shallow water, while usual, is not invariable. The most important condition for the formation of ripple-marks is motion; and any thing competent to produce motion at the bottom of deep water may form them. Wind-waves on the Atlantic are said to have brought sand to the surface from a depth of five hundred feet, and they must be supposed to produce at a still greater depth the gentler agitation necessary for the formation of ripple-marks.

The association of the Kansas ripple-marks with fine argillaceous rocks is perhaps unprecedented, but there seems no theoretic reason to regard it with wonder. Fine sediment does not usually come to rest in spots where the water is subject to agitation, but exceptionally it does; and the centre of every shallow pond with a muddy bottom affords an illustration. Some years ago I observed ripple-marks on a surface of fine river-silt at the bottom of a pool which had communication with a rushing river. The pulsation of the torrent communicated agitation to the pool, but no current; and I inferred that the pulsatory agitation caused the rippling. The pool shared to some extent the muddiness of the river, and the silt on its bottom was evidently a forming deposit. Not far away the bank of the same river exhibited in section

a deposit which seemed identical with that forming in the pool, the ripple-marks being represented by undulations of the laminae. A remarkable feature of the section was the coincidence of the ripples through a vertical space of about eighteen inches. All the laminae were inflected in the same way, so that the corresponding parts of the undulations fell in the same verticals, as illustrated in fig. 1.

It occurred to me, that there might be in this feature something analogous to the assumption of stable

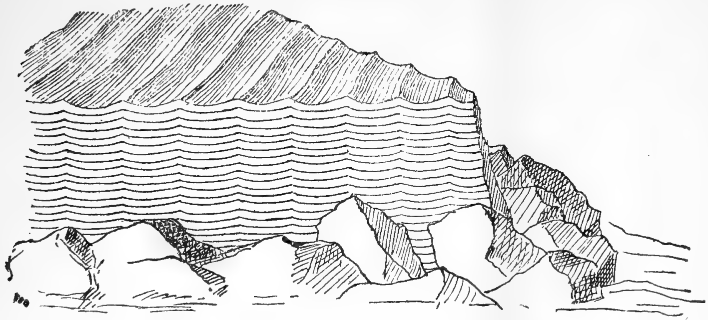


FIG. 1.

figures by free particles on the surface of a vibrating plate, and that the development of this idea might lead to a better theory of the origin of ripple-marks. The common theory, which makes the ripple-mark the homologue of the sand-dune, implies a forward movement of the ripple in the direction of the water-current, and is manifestly inapplicable to the phenomenon just described. I am disposed to doubt its applicability even to ripple-marks produced by currents; for there is a certain class of these, intimately related to small obstructions, which are certainly as stationary and constant as the water-waves on the rapid of a stream.

The analogy of ripple-marks to vibrations in elastic bodies is further illustrated by variations in the forms of the ripples, and by the combination of sets of ripples. The other figures show in profile four forms of ripple observed on upper surfaces of triassic sandstone in south-western Utah. They were carefully drawn from hand specimens. Figs. 2 and 3 are the prevalent forms. In fig. 3 the crest is acute, and the broadly curved trough is midway between the crests. In fig. 2 the crest and trough are moderately acute, and the trough is nearer to one crest than to the other. In fig. 4 the crest is broadly curved, and the trough is less so. In fig. 5 each ripple has a subsidiary crest upon one slope. The resemblance of this last to certain phonographic curves suggests itself at once. In other specimens two systems of ripples co-exist, intersecting at various angles; and the fact that this relation was observed repeatedly, leads me to think that the two sets were synchronously formed. If synchronously formed, there is something in their production analogous to the co-existence of independent and diverse vibrations in elastic bodies.

I do not venture to assert that the correspondences here pointed out are more than superficial analogies, but they suggest a line of investigation which should be fruitful. Such investigation I had intended to undertake, and the accompanying figures were engraved in pursuance of this intention; but, having found myself for some years unable to pursue the subject, I despair of commanding the necessary time and facilities, and avail myself of this opportunity to communicate my observations to the scientific public, in the hope that they may assist in the elucidation of the subject by another. G. K. GILBERT.

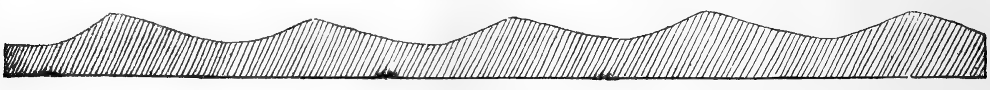


FIG. 2.—Natural size.

FIG. 3.—Two-thirds natural size.

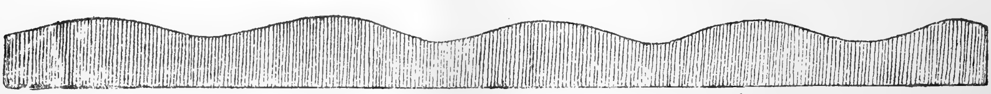
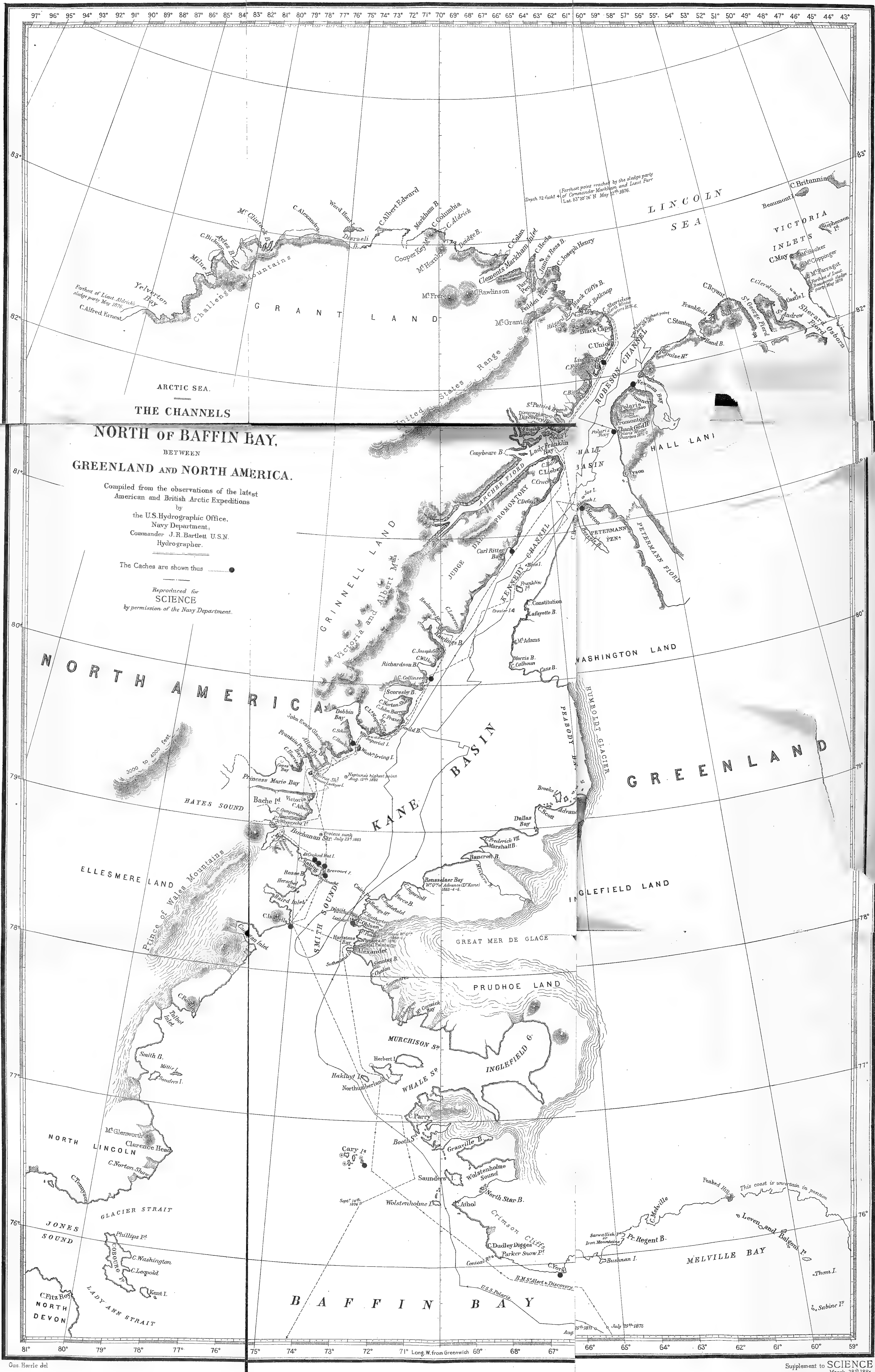


FIG. 4.—Natural size.

FIG. 5.—Natural size.

The 'Batrachichthys.'

The publication of the *Archivos do museu nacional* of Brazil began in Rio de Janeiro in 1876. In the second issue, that for the second and third trimesters of 1876, the director of the section of zoölogy and comparative anatomy in the museum published a description of what he denominated 'an extremely curious little animal called Batrachichthys' The author evidently believed he had found a 'missing link,' and, as it were, he laid his prize at the feet of Darwin, Haeckel, and Martius with the greatest solemnity.



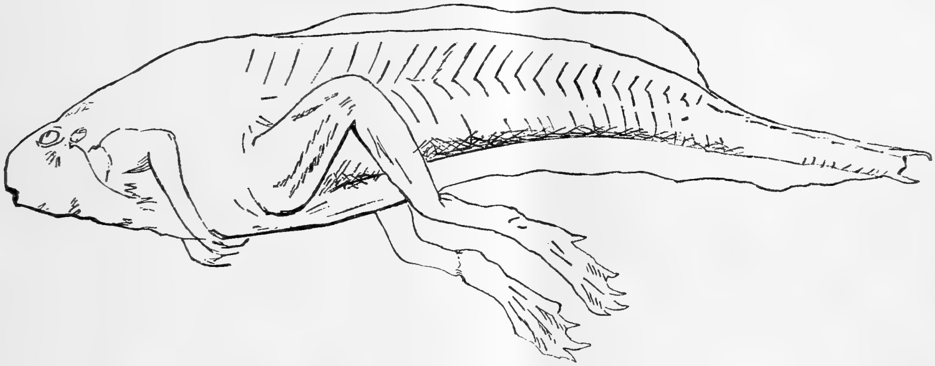
Gus. Horrle del

Supplement to SCIENCE
March 28th 1884.

Although the name of Prof. C. F. Hartt appears as that of one of the editors of the archivos at the time (he resigned shortly after the publication of this article), it is due his memory to say that he objected to the publication of the article referred to, and did all in his power to prevent it, well aware that it would bring ridicule upon the editors and upon the national Brazilian museum, of which he was a director. Notwithstanding Professor Hartt's protestations, the description appeared, accompanied by a plate, from which the accompanying figure is copied.

Mr. S. W. Garman afterwards called attention to the absurdity of making a new genus of this animal, which he shows to be an undeveloped form of a species of Pseudis (*American naturalist*, October, 1877).

More recently this 'extremely curious little animal' has come to the surface again, this time in the French academy. Especial attention was called, in that body, to the first volumes of the Brazilian archivos; and this description of 'a curious batrachian' was spoken of as 'a valuable essay' and 'particularly deserving attention' (*Pop. sc. monthly*, January, 1884, p. 428).



Agreeing with Professor Hartt in regard to its being nothing more than an unusual tadpole, I was anxious to obtain specimens of the animal in the various stages of its development, and thus make an ocular demonstration of the correctness of our opinions.

My work upon the Imperial geological survey, and later other duties, made it necessary for me to travel in almost every part of Brazil, and in some parts of the Argentine Republic and Paraguay; but nowhere could I find or hear of any such animal as that described in the archivos. Along the Paraguay River, which I traversed from its mouth to its source, I made especial effort to find it; for the specimen figured was said to have come from Paraguay. At length, during a trip made in 1882-83 to the interior of the province of Pernambuco in Brazil, I was so fortunate as to obtain a number of good living specimens; and it goes without saying, that they showed the Batrachichthys to be a mere tadpole. They were taken in an artificial pond near the village of Bonito, toward the end of January, 1883; being found in all stages of development from the tadpole to the full-grown frog, although the very young tadpole could not be had on account of the lateness of the season.

About Bonito these tadpoles are called *cacotes*. They are not uncommon in ditches and ponds, and sometimes occur in such numbers as to seriously interfere with fishing with the net. The full-grown frogs are called *sapos verdes* (green frogs). They are said to live in the weeds and rushes about the margins of the ponds; and, when disturbed, they jump into the water. In regard to these popular names, it should be remarked, however, that they are too general to lead one to suppose that they are applied to this species of frog alone throughout Brazil.

The specimens collected by me are now deposited with Professor Wilder at Cornell university.

JOHN C. BRANNER.

Geological survey of Pennsylvania,
Scranton, Penn.

THE GREELY SEARCH.

THE report of the board called to consider the plans of the relief expedition has been printed, and its principal features have been made public through the daily press. Two vessels have been purchased which there is every reason to believe are well suited for the work; and through the graceful courtesy and generosity of the British government, the Alert, well known as the advance ship of the Nares expedition of 1875-76, has been put at the disposition of the United States, without money and without price. A more timely and felicitous service could hardly be rendered; and the sentiment of the country in regard to it is well expressed in the communication of the 21st ultimo to congress from the president and secretary of state.

The position of affairs is about as follows: the Greely party were landed in August, 1881, at Discovery Harbor, with rations equivalent to supplies for three years on the basis used in the U. S. army; with beans, sugar, coffee, canned goods, and antiscorbutics, not embraced in the regular official ration, to the extent, as alleged, of about one year's additional provisions. Beside this, Lieut. Greely reported that about three months' supplies of fresh musk-ox meat had been killed before the departure of the returning vessel. It must be remembered, however, that the demand of human nature for food in these regions is greater than in more temperate climates; and the extra

supplies above mentioned would probably be consumed, together with the regular ration, instead of serving to extend it over a longer period. There is every reason for believing that the supply of fresh meat or game at the station is extremely precarious, accessible only during a few summer months, and perhaps practically absent in certain years. There is therefore reason to suppose that the supplies of the expedition will be entirely exhausted by the beginning of next winter.

On the failure to reach the party in 1882, it may be supposed that every care would be taken by its commander to economize supplies for the retreat last fall. This could not be carried very far; because the stamina of the men, already weakened by two years of arctic exposure, would not bear any great reduction of the ration. It is probable that Greely would have learned by the second summer, that delaying until September might prove fatal to his plan of retreat. He probably started south, if at all, in July or August, 1883. We assume that the party were living and in reasonably good health at that time.

The distance from Discovery Bay to Cape Sabine (see map) is about two hundred and fifty miles. The shore is bold and precipitous; the northern half compact, and almost without inlets or bays; and the usual ice-foot along the rocky walls of Kennedy Channel is, on this side, liable to be much broken by the grinding of floes against it. In this stretch of coast there are three caches of provisions. The first, at Carl Ritter Bay, seventy-five miles south from Lady Franklin Bay, contains two hundred and twenty-five rations, deposited by Greely himself in 1881, and sufficient to sustain his party for nine days. Sixty-two miles farther south, at Cape Collinson, are ten days' provisions, left by Nares in 1875. Fifty miles farther south, at Cape Hawkes, is a cache of unknown extent, but which Greely thought, in 1881, would subsist his party for two months. These, however, were partly in bad condition in 1881, and probably still worse in 1883.

Of the dogs taken by Greely, only eleven survived until the date of his last report, a number hardly more than sufficient to haul their own food from Lady Franklin Bay to Cape Sabine. It may be assumed that any attempt of the Greely party to retreat by means of sledges alone, would be unsuccessful and disastrous. If attempted, it probably would result in a return to their old quarters later in the season, as their only safety for the winter. Sledging over the hummocks of Kennedy Channel and Kane Basin is terrible work, and not to be compared with that done on open field-ice, like that of the sea north of Robeson Channel, or that crossed by Anjou, Wrangell, and De Long.

The practicability of a successful retreat to Cape Sabine, we believe, depended entirely upon whether the party were able to use their boats, and avail themselves occasionally of their sledges to make portages over ice isthmuses in their way. They were furnished with boats prepared especially for the purpose, besides a steam-launch, for which an abundant supply of coal might be procured from the coal strata near the station.

It is improbable, unless continuous water communication happened to favor them, that the party could transport their effects and records, together with a year's provisions for all hands. They could hardly take, in the four boats, more than eight tons besides themselves, and probably not more than six tons if any coal was carried in the launch. A year's provisions for all hands would weigh over fourteen tons. It would be necessary, therefore, for them to rely upon the stores they expected the relief-ship to cache on the east side of Grinnell Land in 1882, and upon the other caches already mentioned, to supply the deficiencies of their means of transportation.

It is highly probable, also, if the strength of the party had in any way become seriously impaired, that they would find it necessary (failing continuous land-water along the Grinnell Land coast) to abandon all but two of their boats, and as much of every thing else as they dared, to get through to the southern entrance of Kane Basin. Whether, if arrived at Cape Sabine, the caches there would suffice to pass them safely through the winter, does not seem to be certain from the rather confused statements in regard to it. It is also possible (as happened to the English on some occasions) that the condition of the ice alongshore might be such that the caches at Carl Ritter Bay or Cape Collinson, or both, might be inaccessible from the water.

We may conclude from the above facts and assumptions, that (1°) if the Greely party were able to use their boats, and reached Cape Sabine safely last fall, the probability of finding them there at open water is reasonably good; (2°) if they were not able to use their boats, they either wintered at the station (in which case they are probably in fair condition, but will be reached with difficulty, and must be reached within the year to save them), or they made an attempt to sledge southward to Cape Sabine, and can hardly have escaped serious disas-

ter; (3°) if they reached Cape Sabine, they are there at present, unless forced to attempt the transit of Smith Sound, — a task fraught with such difficulty that it may well be doubted if they could accomplish it. If accomplished, the absence of provisions expected to be found there would prove a grievous disappointment, and possibly the cause of disaster. But we think the prospect of the party, as a whole, reaching the eastern side of Smith Sound, to be almost unworthy of serious consideration, were it not that in matters like this nothing is unworthy of consideration.

The report of the board is sound and judicious, and was doubtless founded in great part upon the wise counsel of men like Nares and Schwatka, which is appended. It recommends a bounty to be offered for the recovery of the party, if north of Cape York, as urged in this journal and by various competent arctic experts among those consulted.

Since then the secretaries of the navy and war departments have united in a letter to Congress, which is too lamentably absurd to be any thing but comic. It has been well answered by Mr. George Kennan in the *New York herald* of March 19. That those poor, dear, stupid sealers and whalers might get themselves into trouble by rushing in where the navy is so much better fitted to tread, is essentially the reason offered by these landsmen as proof of the inadvisability of a reward. The common sense of mankind will put a right value on such a plea. The necessity for competent ice-navigators is sufficiently evident to any one, and is recognized by the board in its report. The necessity of leaving the ice navigation absolutely to their judgment is hinted at by Schwatka in his letter to the board, and much more fully developed by him in an interview published in the *San Francisco post* of March 1. Upon this much depends, as the experience of the Proteus in 1883 gives evidence.

The plans of the expedition are not yet fully matured, or at least not officially made public. It is stated that the Bear will sail, about April 25, to St. Johns, Newfoundland, to coal, take dogs on board, and proceed at the earliest possible moment to Disco and Upernavik, which it is hoped will be reached about the third week in May. The Thetis will follow from New York about May 1, coaling at St. Johns, and convoying a coal-steamer to Upernavik; when all three will proceed toward Cape York and Littleton Island, or Port Foulke, opening communication with the Eskimo at the earliest opportunity.

The Alert should arrive at Upernavik by June 1, and proceed during the month toward Littleton Island with the intention of providing a station to fall back upon for the crews of the two advance vessels, and later to send a sledge-party along the east coast of Smith Sound as far as the Humboldt glacier. This duty completed by Sept. 1, and the advance vessels not having been heard from, the Alert should return to St. Johns with her report.

The programme for the Alert is open to severe criticism. It cannot be too often repeated, that nearly all the chances are against any of the Greely party having reached the east side of Smith Sound, unless from Cape Isabella. The relief-vessels must follow the land-water on the Grinnell Land shore, to make northward progress. If they come to grief, they will have to retreat by that shore; and for them, as for the Greely party, a station on the Greenland side will be of no use, beside adding greatly to their perils — unless Smith Sound is navigable for small boats, which is hardly to be expected, late enough for a party wrecked north of latitude 79° 30′ to reach the Greenland side. The sledge-party along the Greenland shore will be useful only as a training in sledging for the youngsters. Here it may be observed that the report of the board contains a drawing of a new kind of sledge most ingeniously contrived to be worthless in the arctic regions. It weighs two hundred pounds, and contains bolts, bars, rivets, and varieties of metal, — enough to delight a locksmith, and, at arctic temperatures, keep him more than busy mending the breaks, and the surgeon as much so alleviating the blisters, which would rise wherever bare skin touched it.

It is understood that the expedition is to be commanded by Commander Winfield S. Schley, who will take charge of the Thetis, with Lieut. Uriel Sebree as executive officer, Lieuts. Emory Taunt and S. C. Lemlsy, Ensign Harlow, Chief-engineer Melville, and Passed assistant surgeon Green. The officers of the Bear will be Lieut. W. H. Emory (commander), Lieuts. Colwell and Reynolds, Ensign Usher, Engineer John Lowe, and Dr. Ames. The Alert will be commanded by Commander George W. Coffin, assisted by Lieut. Charles J. Badger and others not yet named. It is, of course, possible that changes in these details may occur at any time before the expedition departs. No opportunities are to be afforded for scientific observations not inevitable to the voyage — unless, perhaps, on the Alert, which returns to civilization.

That the expedition, in spite of crudities of

conception and inexperienced *personnel*, will do good work, we have no doubt; for it is the saving grace of our American navy, that its officers are apt in utilizing brief experience, fertile in expedients, and bold in execution of a task before them.

THE GREAT VIENNA TELESCOPE.[1]

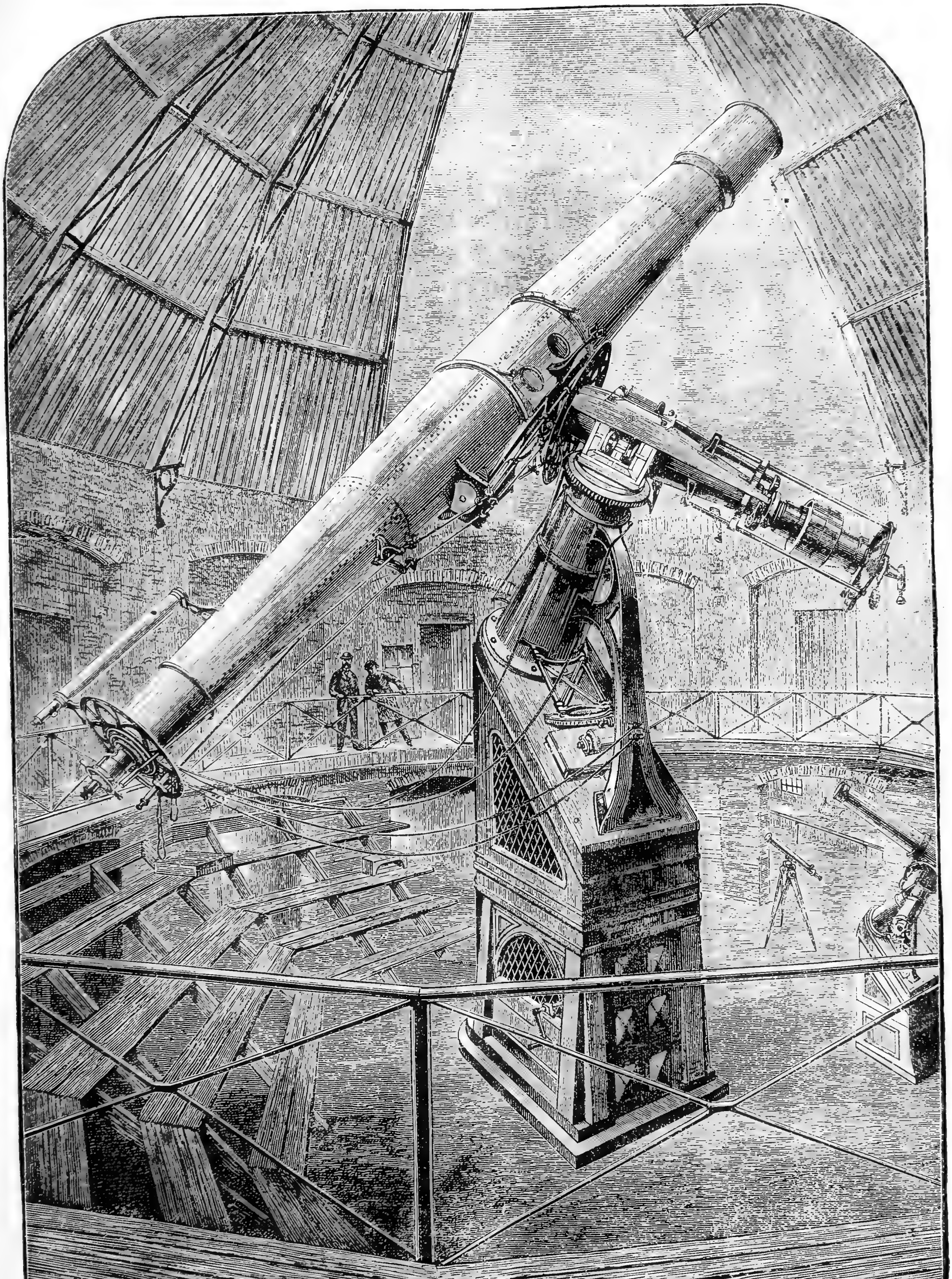
AMONG the instruments which I have examined, that to which most interest now attaches is the great telescope recently completed for the Imperial observatory at Vienna by Howard Grubb of Dublin. It is the largest refracting telescope in actual use at the present time, being of one inch greater aperture than that of the Naval observatory at Washington. The contract was made with Mr. Grubb in 1875; but, owing to difficulties in procuring glass disks of the necessary size and purity, it was not completed until 1881. Further delays occurred in mounting, so that it was scarcely ready for actual work at the time of my visit in April last. I made as critical and careful examination of its working as was possible during the unfavorable weather which prevailed at Vienna at that time. My examination was principally in the nature of a comparison of its working with that of the Washington telescope.

General character of mounting. — In its main features the telescope is mounted on the same general principle with that at Washington. Both of these instruments are counterpoised on the German plan. The tubes of both are of steel. The rapid motion in declination is by means of a rope attached to the two ends of the tube, and that in right ascension by a system of wheel-work. The clockwork is in the pier below the instrument. The leading points of difference are, that the mounting of the Vienna telescope is much larger, stronger, and heavier in all its parts; that the contrivances for making use of it are more numerous; that an elaborate system of friction-rollers in declination is provided, the Washington telescope having none; and that a more convenient system of illuminating the field and the divisions on the several circles has been adopted.

Ease of motion. — In moving the Vienna telescope, one is at first struck with the fact that mere weight is a serious drawback; but when the motion is once commenced, the movement in right ascension is almost as easy as in the Washington telescope. It is, however, very different in declination. For reasons which neither Dr. Weiss nor myself were able to perceive, the friction-rollers seemed to be of no benefit in easing the motion in declination, which was much more difficult than in the Washington telescope, and, in fact, quite a task upon the strength of the observer at the eye-piece. The quick motion for setting in right ascension is made below the end of the polar axis by turning a steel steering-wheel. This appliance is in every way inferior to the system at Washington, where the same motion is effected by an endless rope hung over a grooved wheel, which the observer turns hand over hand. By this motion the observer at the Washington telescope can make the required motion without taking his eyes from the telescope or the vernier, and without giving any thought to the motion of his hands. But the handles of the steering-wheel are much less convenient to take hold of than a rope; and, if the motion is at all rapid, the operator must be on the alert lest the steel handles strike his knuckles in the attempt to take hold of them without looking. The necessity of care in this respect makes the motion slow and laborious.

Clock-motion. — On the system of the Messrs. Clark, applied in the Washington telescope, the screw which turns the sector does not take hold of the circumference of the latter directly, but gears into a complete wheel, the axis of which is connected with the arc of the sector by a pair of brass or steel bands. By this arrangement the toothed wheel makes a nearly complete revolution while the sector is moving through its arc; and the effect of the small unavoidable irregularities in the working of the screw is diminished in the ratio of the arc of the sector to the circumference of the wheel. Whatever advantages this arrangement may have in small instruments, I think that in large ones they are more than counterbalanced by the evils arising from the elasticity of the band, combined with the changes of friction, the action of the wind, and other forces acting to vary the uniform motion of the telescope. Owing to this elasticity, the effect of the wind or of any slight pressure by the observer on the eye-piece is many times greater in the Washington than in the Vienna instrument. But it did not appear to me that the firmness of the connection in the latter instrument between the support of the turning-screw and the tube of the telescope was as great as supposed by those who lay stress on large and stable mountings. I found that, by a simple pressure of the thumb-nail upon the eye-piece of the

[1] Extract from a report to the secretary of the navy on recent improvements in astronomical instruments, by SIMON NEWCOMB.



Vienna telescope, the pointing in right ascension could be changed by a number of seconds, so as to throw an object entirely away from the wire. The main question is, however, the steadiness of motion when no pressure whatever is applied by the observer or the wind; and, so far, I have found no large telescope which is entirely satisfactory. The Vienna telescope was not supplied with a micrometer at the time of my examination, so that I could not test its motion as thoroughly as I wished to; but, by bringing the planet Uranus in the edge of the field, I found that there was constantly an irregular movement in right ascension, the amount of which I estimated as between one and two seconds of arc. This movement had no regular period, and therefore did not seem to be connected with any defect in the figure or motion of the screw. Its irregular period, if I may use the term, varied from the smallest appreciable amount to two or three seconds of time. Its most probable cause seemed to be the irregular friction of the motion in right ascension, and especially of the friction-rollers, by which the polar axis is supported at its lower end. A similar irregularity is noticed in the Washington telescope; but I think it is decidedly less than in the Vienna one, provided that no strong wind is blowing on the instrument.

Arrangement of sector. — In Mr. Grubb's large telescope an attempt is made to give greater stability to the screw by having its axis immovably fixed to supports in the massive base of the telescope, which renders it incapable of any motion except that of turning. The screw cannot, therefore, be unlocked from the sector, as in the instruments by other makers. When the sector reaches the end of its motion, it is to be turned back by giving a rapid backward motion to the screw itself, for which special apparatus is provided. From what I have already said, I am of opinion that this arrangement offers no advantage to compensate for the trouble which it causes the observer.

Slow motion. — The slow motion in right ascension in the Vienna telescope is endless, instead of being confined between narrow limits, as in that at Washington. This is a decided improvement, saving the observer much loss of time from the motion running out.

Illumination. — The apparatus for illuminating the field of the micrometer was not in perfect order at the time of my visit, so that I need not report upon it in this connection. It is in its general character similar to the system adopted by the Messrs. Repsold, of which I shall speak hereafter. The illumination of the divisions of both circles leaves nothing to be desired.

Minor points. — In the preceding I have indicated what may be considered fundamental points affecting the use of the instrument. There are, however, several minor points which are of almost equal importance, so far as the practical use of the instrument is concerned. As the instrument now stands, the drawback which strikes me most was the absence of any rough setting, either in right ascension or declination, and the impossibility of seeing, even approximately, the pointing in declination, except when the observer is at the eye-piece. This, when combined with the great force necessary to move the telescope in declination, makes its pointing a difficult and troublesome operation. The observer must first set the telescope by pure guess-work. He has then to mount to the eye-piece, wherever it may be, look into the microscope, and note the reading of the circle. He has then to withdraw his eye, and, by considerable muscular exertion, to make another guess, which he can test by again reading the circle. Thus the pointing is to be made by a series of trials, which are so troublesome that I found the observers were in the habit of mounting to the top of the clyinder in the dome, and finding the pointing in declination by moving the telescope around the horizon.

I remark, in this connection, that the Washington telescope has a coarse setting, which the observer can read from any point below the telescope with the aid of an opera-glass.

Objective. — The proper figuring of a great objective so as to give the best possible image of a celestial object is justly considered the most difficult task in the construction of a large telescope: especial interest, therefore, attaches to Mr. Grubb's success with the objective. The atmospheric conditions were very unfavorable to the finest tests, but I succeeded in making such examination as the circumstances admitted on three evenings. On the first trial the image was found to be distorted, owing to want of adjustment of the glass itself. This was soon corrected by Director Weiss. On the second trial I found a well-marked spherical aberration, which seemed, however, to be very regular from centre to circumference. But there had been a fall of temperature, and the dome had been opened but a short time, — circumstances under which the Washington telescope always exhibited the same phenomenon. On the third evening the dome had been opened long enough to nearly equalize

the temperatures. So far as I could judge, the character of the image was perfect, there being no appearance of those rings of different focal lengths which are commonly seen in large objectives. As I had not used a large telescope for some eight years, I could not feel that my judgment was an entirely critical one; but I am persuaded, that, if any defects exist, they are so minute as not to interfere in the slightest with the finest performance of the instrument.

I have been led by the examination above described, combined with some experience in the use of the Washington telescope, to some conclusions respecting the most appropriate features in the mounting of an instrument of the largest size. They may here be enumerated for the consideration of those engaged in constructions of this kind.

1. I think, that, in order to secure the necessary stiffness with the least weight, the axes should be hollow. The material can then be made comparatively thin. It is true that the greater the friction, the larger the axis; but the mass of metal in the interior of the axis contributes so little to its stiffness that the external diameter will have to be increased very little to secure the same stiffness with the hollow axis as with the solid one.

2. It is not worth while to supply the declination-axis with friction-rollers, unless experiment and research shall show that they can be made more effective than they appear to be in the Vienna instrument.

3. The best quick motion in right ascension is that adopted in the Washington telescope, where the observer pulls an endless rope hand over hand, and can lock and unlock at pleasure the gearing which connects the turning-wheel with the telescope.

4. If, as is probable, the quick motion in declination by means of the loose rope attached to the two ends of the telescope requires too strong a pull, the best method of giving this motion is through a gearing turned by an axis passing centrally through the polar axis, on the Repsold plan; but it is desirable to have this motion made by turning a crank, or pulling a rope, rather than by taking hold of the wheel.

5. Coarse divided wheels should be supplied, so that the observer, while turning the instrument, can constantly see its approximate pointing. It is better if this coarse reading can be made with the naked eye, as is the case with the right-ascension movement in Washington. The declination-circle, being farther from the observer, has to be read with an opera-glass if more than a coarse fraction of a degree is required. By such an arrangement the telescope can always be set by the quick motion so nearly that any object sought shall be in the field of view of the finder. In nine cases out of ten this will be all that is required in practical use. It should never be forgotten that in all quick motions it is very desirable that the observer should be able to keep his eye upon the movements of the telescope itself, so to save him from even a groundless apprehension that something may be going wrong.

6. The slow motion should, if possible, be endless. There is no difficulty in making it so in right ascension: there may be, however, in declination.

7. When the instrument is so large that there is an interval of three feet or more between the centre of the polar axis and the side of the tube, the screw which communicates the clock-movement should be geared into a complete circle rather than into a sector. The use of a metal band to multiply the intervening radius of the wheel offers no advantage, in the case of large instruments, to compensate for the disadvantage of want of stability arising from elasticity of the band and its fastenings.

8. In this connection the question arises of applying the Greenwich system, which consists in setting the hour-wheel so that its position shall correspond to sidereal time, and clamping to it a second wheel corresponding to right ascension. Every practised astronomer is familiar with the trouble in setting an ordinary equatorial, arising from the necessity of having to calculate the constantly varying hour-angle of the object on which he points. With the Greenwich arrangement there is no such trouble. The worm-wheel being once set to sidereal time, the observer has only to set the other one to the constant right ascension of the object. It is true that practical difficulties arise in the usual construction, owing to the fact that the vernier on the gear-wheel will from time to time be on every point of the circle; but this difficulty can, I think, be obviated by appropriate arrangements.

9. A clock-motion which can be kept up by water or other power is greatly preferable to any system which requires an assistant to wind up a weight.

10. The entire practicability of illuminating the divisions of the circle by lamps, and of reading these divisions from the eye-end of the telescope, has been so completely demonstrated, that all large instruments should be supplied with this arrangement.

11. The system of illuminating wires, field-micrometer slit, etc., by a single lamp which

shall be vertical in all positions, has been so perfected by the Repsolds, that it leaves nothing to be desired.

12. The Washington plan of having the whole micrometer-plate, including both fixed and movable wires, moved by a fine screw, offers such a convenience in setting, that it should always be adopted.

13. The old system of having a single finder on that side of the telescope which is opposite the declination-axis becomes very inconvenient in a large instrument, owing to the necessity of setting the slit in the dome, not only to the telescope, but to the finder. The plan adopted in the Vienna telescope, of having two finders, — of which one shall be above, and the other below, the telescope when the latter is in the meridian, — obviates this difficulty, and should always be adopted.

THE AMERICAN AWARDS OF THE GEOLOGICAL SOCIETY OF LONDON.

We give below the text of the addresses on the occasion of the awards to Dr. Leidy and Mr. Lesquereux at the annual meeting of the Geological society of London in the middle of last month.

The president handed the Lyell medal to Prof. W. H. Flower, F.R.S., for transmission to Dr. Joseph Leidy, F.M.G.S., and addressed him as follows: —

Professor Flower, — The council has bestowed on Dr. J. Leidy the Lyell medal, with a sum of twenty-five pounds, in recognition of his valuable contributions to paleontology, especially as regards his investigations on the fossil Mammalia of Nebraska, and the Sauria of the United States of America. These vast, and, in comparison with our own country, but little explored, territories have for some years past yielded a harvest of fossil vertebrate remains of exceeding richness, of which we have no example here. How well this harvest is being garnered by our trans-Atlantic *confrères* the flood of memoirs published by them during the last quarter of a century bears witness. Amongst these scientific laborers in the paleontological harvest-field, Dr. J. Leidy has held a foremost place. Careful in observing, accurate in recording, cautious in inferring, his work has the high merit which trustworthiness always imparts. The well-nigh astounding number of papers written by him between 1845 and 1873 (amounting to a hundred and eighty-seven), his reports on the 'Extinct vertebrate fauna of the western territories,' his 'Synopsis of the extinct Mammalia of North America,' and his 'Cretaceous reptiles of the United States,' testify to the fertility of his pen.

Professor Flower, in reply, said: — Mr. President, as I have profited so deeply by Dr. Leidy's paleontological writings, and also have the pleasure of his personal friendship, I was much gratified by his request, communicated to me by telegraph a few days ago, that I would represent him on this occasion, and receive from your hands the award which the council has so worthily bestowed. By the same means of communication, he mentions the interesting incident, that it was by Sir Charles Lyell's advice, given to him in Philadelphia about thirty years ago, that he was induced to abandon the study of medicine and take up paleontology. A letter which I understand Dr. Leidy has written, in which he doubtless has expressed his own thanks to you, has not yet reached me; but I am quite sure that this recognition of his valuable labors in that marvellously fruitful field of discovery, the extinct vertebrate fauna of North America, will be greatly appreciated by him and by his fellow-countrymen, by whom he is so justly esteemed.

The following is the letter from Dr. Leidy, mentioned by Professor Flower: —

Philadelphia, Penn., 1302 Filbert Street,
Feb. 7, 1884.

My dear sir, — I have just this minute received your note of Jan. 25, and hasten to reply, that there may be no delay in my answer, for the anniversary meeting of Feb. 15. I was equally surprised and delighted at the action of the council of the Geological society in awarding to me the Lyell medal and its accompaniment. Such approbation of my services I regard as rich compensation, added to the pleasure derived from my labors. I must add that I feel as if Sir Charles Lyell himself was expressing satisfaction, in consideration of my having complied with his wish, when thirty years ago, in my own home here, he said he hoped I would devote my time to paleontology instead of medicine.

Please present to the Geological society my warmest thanks for the honor it has conferred upon me. I have written to Prof. W. H. Flower, asking him to receive the award on my account.

With sincere regard,
Joseph Leidy.

Mr. Warington W. Smyth,
For. sec. Geol. soc.

In handing to Professor Seeley, F.R.S., a second portion of the proceeds of the Barlow-Jameson fund for transmission to Professor Leo Lesquereux, F.C.G.S., the president spoke as follows: —

Professor Seeley, — The council has awarded to Professor Leo Lesquereux the sum of twenty pounds from the proceeds of the Barlow-Jameson fund, in recognition of the value of his researches into the paleobotany of North America, and to aid him in further investigations of a similar kind. Professor Lesquereux's 'Contributions to the fossil cretaceous and tertiary flora of the western territories,' published in the 'Reports of the U. S. geological survey,' are works which, for their matter, typography, and illustrations, leave nothing to desire. In transmitting this award to Professor Lesquereux, you will convey to him the hopes of the council that it may assist him in prosecuting further investigations in the difficult branch of research in which he has already accomplished so much.

Professor Seeley, in reply, said: — Mr. President, I

feel much honored in receiving this award on behalf of Professor Lesquereux. His valuable researches not only contribute systematic descriptions of the American secondary and tertiary floras, but furnish almost the only data for comparing those floras with the plant-life from similar strata on this side of the Atlantic. All Professor Lesquereux's work is marked by such exactness and care, that I am glad we are thus able to honor it, and offer assistance in its progress.

THE DIFFICULTY OF PREVENTING THE OHIO FLOODS.

WILLIAM E. MERRILL, lieutenant-colonel U. S. engineers, in charge of the government improvements in the Ohio River, has, at the request of the editor of the *Cincinnati commercial gazette*, made public his views respecting the causes of the Ohio floods, and discussed the possibility of their mitigation in a letter published in the issue of March 8 of that journal.

In attempting to estimate the influence of forests, he says, experience has proved that the clearing and cultivation of level land have comparatively small effect upon floods, and may be left out of account: disastrous effects follow only when the hill and mountain sides are put under cultivation. The evil results of denuding the hills of trees are then illustrated by references to Spain, Palestine, Greece, parts of Italy and France, and the good results of reforesting the slopes of the French Alps noted.

Above Cincinnati the watershed drained by the Ohio comprises the western third of Pennsylvania, the whole state of West Virginia excepting four counties, the eastern part of Kentucky, and nearly the entire state of Ohio. Now, leaving out of consideration the more level portions of this area, the question is, whether its hilly and mountainous parts have been cleared of forests to such an extent as to materially affect its capacity to retain the rainfall, and so to call for legislative action to prevent greater calamities in the future. Col. Merrill answers this question emphatically in the negative. Speaking from an extended personal knowledge of the states of Pennsylvania, West Virginia, and Kentucky, which comprise the hilly portion of the Ohio basin, he says we are very far from having attained that state of forest destruction which would require the intervention of the government for the protection of the river-valleys in this manner. Any one who travels on the railroads which cross the Alleghanies sees that the country is still heavily wooded, while away from the lines of the railroad it is still a wilderness, except in a few isolated valleys. Even the removal of the merchantable timber from the country would do no especial damage, provided the underbrush and smaller trees were left to protect the soil. We thus far have no sure ground, he remarks, for asserting that man's interference has had any marked influence upon the discharge of the Ohio.

In sharp contrast with these views of Col. Merrill is an article on forests and floods in the *New York independent* for March 6 (p. 30), by Mr. N. H. Egleston of Washington, D.C., in which the basis of argument seems to be furnished by the map prepared by Professor Sargent to illustrate the census returns in regard to the condition of the forests, and more particularly by a careful examination of the amount of woodland now existing in the state of Ohio as compared with that of twenty years ago.

As the state is not much of it hilly, the argument appears in so far to be inconclusive, although the author states and explains the popularly accepted theory of the controlling influence of forests with great skill, and without hesitation ascribes the Ohio floods to their destruction. But Col. Merrill very pertinently remarks that the traditions of the aborigines show that even the great flood of 1884 was equalled by floods which occurred before white man's axe felled a single tree in the valley of the Ohio.

Whatever may be thought of the relative value of opinion upon this question, there is no doubt that Col. Merrill speaks as an expert and an authority when he treats the problem of controlling the surplus waters of the Ohio by artificial means. He says, the idea that it is possible to build a number of reservoirs in the mountains to store up water during freshets, and let it out during the scarcity of summer, is an old one, and one which has been discussed and abandoned in case of various European rivers. It was, moreover, advocated by the able engineer, Charles Ellet, jun., and vigorously pressed upon the attention of Congress. When the improvement of the Ohio was taken in hand by the government, after the close of the civil war, this scheme was practically investigated by W. Milnor Roberts, whose long engineering experience in railroad and canal construction in western Pennsylvania, and consequent familiarity with its topography, peculiarly fitted him for this work. After an exhaustive examination of possible sites, and estimate of cost of retaining reservoirs, which will be found in detail in his report to the chief of engineers under the date of April 30, 1870, he concludes thus: "My own careful investigations of the subject of controlling the floods of the Ohio by means of artificial reservoirs, which were made in 1857, satisfied my mind conclusively that such control by human means, attainable within practicable limits of cost, is impossible."

Mr. Roberts then examined another question, which was the practicability, not of controlling the floods at all, but of simply storing sufficient water to provide a supply to supplement the scarcity of the summer to such an extent that the summer flow at Wheeling should not fall below six feet. The reservoirs required to accomplish this were estimated to have a capacity of not less then a hundred and fifty billion cubic feet, and they must store the drainage from a watershed of not less than thirty-six hundred square miles. The estimated cost of accomplishing this with thirty reservoirs was sixty million dollars, a sum out of all proportion to the advantage to be derived from the improvement. Moreover, the dangers attendant upon such reservoirs are too great to justify the construction of even the few reservoirs required to secure a navigable stage of water, to say nothing

of the vastly greater constructions which would be needed in any attempt to control floods. There is special insecurity necessarily inhering in the foundations of hydraulic work such as this, constructed in the bed and banks of running streams. Besides this, mention may be made of the interference which such reservoirs would cause in vested interests, such as mills, factories, railroads, canals, and rafting.

The latter portion of Col. Merrill's letter advises the city of Cincinnati to appoint a commission to define the lines of the river-front for high and low water, and to make it the duty of some public officer to prosecute in case of infringement on the free waterway, so that there may be no future obstruction of the river-channel. He shows that to the present time there has been no perceptible obstruction at this point. He further advises that the lower part of the city, next to the river, be filled by continuing the present slope of the river-banks upward to high-water mark; and then that those squares of the city which stand on the slope be devoted to business alone, and be so solidly built as not to be seriously damaged by an occasional flood, while the houses of the laboring population be removed to other parts of the city.

In conclusion, Col. Merrill says, in reply to the question which has frequently been put to him as to what the government is going to do to try to stop these floods, that, if the government be guided by his advice in this matter, it will do nothing, as the undoubted cause of the flood was the excessive fall of rain and snow; and no means of controlling this has yet been discovered.

AN EXPLANATION OF HALL'S PHENOMENON.[1]

MR. E. H. HALL's original experiment was as follows. A strip of gold-leaf was cemented to a plate of glass, and placed between the poles of an electro-magnet, the plane of the glass being perpendicular to the magnetic lines of force. The current derived from a Bunsen cell was passed longitudinally through the gold; and, before the electro-magnet was excited, two equipotential points were found by trial near opposite edges of the gold-leaf, and about midway between the ends. When these points were connected with a galvanometer, there was, of course, no deflection. A current from a powerful battery being passed through the coils of the magnet, it was found that a galvanometer-deflection occurred, indicating a difference of potential between the two points, the direction of the current across the gold-leaf being opposite to that in which the gold-leaf itself would have moved across the lines of force, had it been free to do so. On reversing the polarity of the magnet, the direction of the transverse electromotive force was reversed; and, when the magnet was demagnetized, the two points reverted to their original equipotential condition. Subsequent experiments showed that the direction of the effect differed according to the metal used. This effect was attributed by Mr. Hall to the direct action of the magnet on the current.

Mr. Bidwell claims that Hall's phenomenon might be completely explained by the joint action of mechanical strain and certain thermo-electric effects. The strain is produced by electro-magnetic action. It will be convenient to refer to the metallic plate or strip as if it were an ordinary map, the two shorter sides being called respectively west and east, and the two longer, north and south. Let the south pole of an electro-magnet be supposed to be beneath the strip, and let the strip be traversed by a current passing through it in a direction from west to east: then the strip will tend to move across the lines of force in the direction from south to north. Since, however, it is not free to move bodily from its position, it will be strained; and the nature of the strain will be somewhat similar to that undergone by a horizontal beam of wood which is rigidly fixed at its two ends, and supports a weight at the middle. Imagine the strip to be divided into two equal parts by a straight line joining the middle points of the west and east sides: then in the upper or northern division the middle district will be stretched, and the eastern and western districts will be compressed; while in the lower division the middle part will be compressed, and the two ends will be stretched. If, now, a current is passing through the plate from west to east, the portion of the current which traverses the northern division will cross first from a district which is compressed to one which is stretched, and then from a district which is stretched to one which is compressed; while in the southern division the converse will be the case. And here the thermo-electric effects above referred to come into play.

Sir William Thomson, in 1856, announced the fact that a stretched copper wire is thermo-electrically positive to an unstretched wire of the same metal, while a stretched iron wire is negative to an unstretched iron wire. From this it might be inferred, as Sir William Thomson remarks, that a free copper wire is positive to a longitudinally compressed copper wire, and that a free iron wire is negative to a longitudinally compressed iron wire; and experiment shows this to be the case. *A fortiori*, therefore, a stretched copper wire is thermo-electrically positive to a compressed copper wire, and a stretched iron wire is negative to a compressed iron wire. If, therefore, a current is passed from a stretched portion of a wire to a compressed portion, heat will (according to the laws of the Peltier effect) be absorbed at the junction if the metal is copper, and will be developed at the junction if the metal is iron. In passing from compressed to stretched portions, the converse effects will occur.

It follows from the above considerations, that, if the metal plate (which is subjected to a stress from south to north, and is traversed by a current from west to east) be of copper, heat will be developed in the western half of the northern division, and absorbed in the eastern half; while heat will be absorbed in the western half of the southern division, and developed in the eastern half. But the resistance of a metal increases

[1] Abstract of a paper read at the meeting of the Royal society, Feb. 21, 1884, by SHELFORD BIDWELL, M.A., LL.B.

with its temperature. The resistance of the north-western and south-eastern districts of the plate will therefore be greater, and that of the north-eastern and south-western districts smaller, than before it was subjected to the stress; and an equipotential line through the centre of the plate, which would originally have been parallel to the west and east sides, will now be inclined to them, being apparently rotated in a counter-clockwise direction.

If the plate were of iron instead of copper, the Peltier effects would clearly be reversed, and the equipotential line would be rotated in the opposite direction.

The peculiar thermo-electric effects of copper and iron, discovered by Thomson, are thus seen to be sufficient to account for Hall's phenomenon in the case of those metals. It became exceedingly interesting to ascertain whether the above explanation admitted of general application; and the author therefore proceeded to repeat Thomson's experiments upon all the metals mentioned by Hall. The results are given in the following table, where those metals which in Hall's experiments behave like gold are distinguished as negative, and those which behave like iron as positive.

Metals.	Forms used.	Direction of current.	Hall's effect.
Copper	Wire and foil, pure.	S. to U.	Negative.
Iron	Wire and sheet, annealed.	U. to S.	Positive.
Brass	Wire, commercial.	S. to U.	Negative.
Zinc	Wire and foil.	U. to S.	Positive.
Nickel	Wire.	S. to U.	Negative.
Platinum	Wire and foil.	S. to U.	Negative.
Gold	Foil, purity 99.9 %.	S. to U.	Negative.
	Wire, commerc. pure.	U. to S.	
	Jeweller's 18-ct. wire and sheet.	S. to U.	
	Jeweller's 15-ct. sheet.	S. to U.	
Silver	Wire and foil.	S. to U.	Negative.
Aluminium	Wire and foil, pure.	U. to S.	Negative?
Cobalt	Rod, 8 mm. diameter.	U. to S.	Positive.
Magnesium	Ribbon.	S. to U.	Negative.
Tin	Foil.	S. to U.	Negative.
Lead	Foil (assay).	No current.	Nil.

S. means stretched. U. means unstretched.

It will be seen that in every case excepting that of aluminium, and one out of five specimens of gold, there is perfect correspondence between the direction of the thermo-electric current and the sign of Hall's effect. With regard to the aluminium, a piece of the foil was mounted on glass, and Hall's experiment performed with it. As was anticipated, the sign of the 'rotational coefficient' was found to be positive, like that of iron, zinc, and cobalt. Either, therefore, Mr. Hall fell into some error, or the aluminium with which he worked differed in some respect from that used by the author. The anomalous specimen of gold, being in the form of wire, could not be submitted to the same test: it probably contained some disturbing impurity.

[To the foregoing article, Dr. Hall has favored the editor of *Science* with the following reply.]

Mr. Bidwell's table is certainly very suggestive, but his 'explanation of the Hall phenomenon' cannot stand.

He makes this phenomenon to be an incidental result of the manner in which the metal strip is attached to the plate of glass. It is, he says, like a beam rigidly fastened at both ends, and weighted in the middle. Without discussing the closeness of this analogy, one can see, that if we fasten the strip by its middle, and leave it free at both ends, the conditions upon which Mr. Bidwell supposes the phenomenon to depend are quite changed.

After reading Mr. Bidwell's paper, I took a strip of soft steel, about one-tenth of a millimetre thick, and made the usual connections, but, instead of fastening the strip to glass with cement, so arranged it that it could at will be clamped across its middle or across the ends to a sheet of hard rubber. The end-clamps were about three centimetres apart, and the width of the magnetic poles between which the strip was placed was considerably greater than three centimetres. Now, when the strip was clamped across its middle and left free at the ends, and was made to conduct a current of electricity across the magnetic field, it was like a beam supported at the middle, and with a load distributed from end to end; but when the strip was clamped at its ends and left free in the middle, it was like a beam supported at both ends, and with a load distributed from end to end. Experiment shows that the effect is positive, as I have always found it in iron and steel, whether the strip be clamped in the middle, or at the ends.

There is one other consideration to be urged. Mr. Bidwell would, I suppose, account for the fact that the observed effect is proportional to the magnetic force by saying that the strain would be proportional to this force. But how will he explain the fact that the effect is nearly or quite proportional to the current, as was shown in my first paper upon the subject? Let us see what his theory leads to. Doubling the current, the magnetic force remaining unchanged, would double the strain. But a doubled strain, with a doubled current, would make the heating and cooling from the Peltier effect four times as great as before. This would deflect the equipotential lines four times as much as before; and, as these lines are only half as far apart as before, the transverse current would be eight times as great as before the direct current was doubled. The transverse effect, then, would be proportional, not to the current, but to the cube of the current. EDWIN H. HALL.

Cambridge.

THE CREVAUX EXPEDITION.

E. MILHÔME writes from Corumba, Sept. 24, 1883, to the Société de géographie in regard to the possible survivors of the Crevaux expedition. He believes that several survived for a time, but were afterward put to death by the savages. Information of any sort could hardly be obtained; as the Tobas had made ready for war, and retired to the interior, holding no further communication with the neutral tribes from whom the previous vague news had been derived by the whites. The Indian survivors, from their terror and sufferings, can afford little help. It is known that Branco, one of the party, in his capacity of soldier, was preserved alive by the natives to instruct them in the use of the fire-arms which they captured; and it is possible he may be still living, but, if so, has

probably been carried far into the interior. It is certain that the Tobas who massacred Crevaux's party are now provided with hatchets, knives, and Remington guns, which they have captured, partly from Crevaux, and partly from the Bolivian expedition of Col. Rivas. They are not, however, so formidable as might be supposed; since it seems their captive instructed them to aim in such a way as to render it almost impossible that any thing of a man's height should be hit by the ball; so that the guns are more terrifying than dangerous to their enemies. The second expedition sent under orders of Col. Fontana accomplished nothing. The third, organized by Col. Sola, and since commanded by Col. Hazetta, is at present penetrating the Chaco region, toward the banks of the Pilcomayo. Another better prepared Bolivian expedition was in contemplation under Col. Campu; but the writer, broken down by fever, was obliged to return to Corumba on his way to Buenos Ayres. He fears that all traces of the expedition of Crevaux are lost; that even their remains cannot be recovered, since the Tobas are in the habit of utilizing the bones as trophies or for religious purposes, so that they would be widely separated and unrecognizable. The vertebrae of the hated Christians are in special demand among the Toba women for use as rattles or rattling pendants worn during their dances. Altogether, the savagery of these Tobas seems to be more energetic than that of any other American aborigines. Milhôme has sent to Paris a complete collection of their arms, tools, instruments, and clothing, with an explanatory catalogue.

On the other hand, M. Paul Armand, in the Bulletin of the Marseilles society for December, without mentioning any date (but published before Milhôme's letter), says that the Argentine expedition to the Pilcomayo arrived safely in the early part of August, at the Bolivian town of Caiza, without the loss of a man, although having fought three battles with the Tobas. They ascended the Pilcomayo sixty leagues beyond the place where the Crevaux party was assassinated. The Bolivian congress has resolved that a colony named after Crevaux shall be established at that point, and that it shall be marked by a monument to the sufferers. Thouar arrived at Caiza on the 12th of July; having heard from some neutral Indians that two survivors, Haurat and Branco, were prisoners with the Choroti Indians of the Rio Abajo. He had had some communication with the Tobas, and obtained some relics, among other things a barometer which had belonged to Crevaux. He intended to leave Teyo about Aug. 10, and pass completely round the north Chaco, on the left bank of the Pilcomayo. In January it was stated to the Société de géographie that Thouar had arrived safely at Assuncion, and was about to embark for France, where he was expected before this time. Nothing further is said in regard to his search for Crevaux; but it is stated that the most important result of his voyage will be the opening of a practicable commercial route between Bolivia and Paraguay, giving opportunities for a reciprocal commerce now valued at twenty million dollars.

A NEW THEORY OF HEREDITY.

The law of heredity: a study of the cause of variation, and the origin of living organisms. By W. K. BROOKS. Baltimore, *Murphy*, 1883. 12+336 p., illustr. 16°.

JAEGER is quoted by Semper as saying that there has been enough Darwinist philosophizing, and that it is now time to subject the numerous hypotheses to the test of investigation. While this is undoubtedly true, some hypotheses are necessary; and even incomplete and erroneous ones may be of great service by offering a series of definite problems for solution, instead of a chaos of facts. "An honest attempt to reason from the phenomena of nature can hardly fail to result in the discovery of some little truth." This is the keynote of the book before us, which is therefore worthy of very careful consideration, however unsatisfactory it may prove to be as an explanation of the great problem of heredity.

The theory proposed in this book is a modification of Darwin's hypothesis of pangenesis, reconstructed with a view of avoiding the many difficulties in the way of that hypothesis. Brooks's theory, very briefly stated, is as follows. 1. The union of two sexual elements gives variability. 2. In all multicellular organisms the ovum and the male cell have gradually become specialized in different directions. 3. The ovum has acquired a very complex organization, and contains material particles of some kind corresponding to each of the hereditary species characteristics. 4. The ovarian ova of the offspring are the direct and unmodified descendants of the parent ovum. 5. Each cell in the body has the power of throwing off minute germs. During the evolution of the species, these cells have acquired distinctive functions adapted to the conditions under which they are placed. When the function of a cell is disturbed through a change in its environment, it throws off small particles, which are the germs or 'gemmules' of this particular cell. 6. These germs may be carried to all parts of the body, and penetrate to an ovum or to a bud; but the male cell has acquired a peculiar power to gather and store up germs. 7. When impregnation occurs, each gemmule impregnates that particle of the ovum which will give rise in the offspring to the cell corresponding to the one which produced the gemmule; or else it unites with a closely related particle, destined to produce a closely related cell. 8. In the body of the offspring this cell will be a hybrid, and tend to vary. 9. The ovarian ova of the offspring inherit the properties of the fertilized

ovum directly, and the organisms to which they give rise will tend to vary in the same manner. 10. A cell which has varied will continue to throw off gemmules, and so cause variations in the corresponding parts of the bodies of descendants, until a favorable variation is seized upon by natural selection. 11. The ovarian ova will directly inherit the selected variation, and will transmit it as an hereditary race characteristic without the agency of gemmules. 12. The occurrence of a variation, but not its precise character, is due to the direct action of external conditions.

These positions Professor Brooks endeavors to establish by a great number of facts, taken almost exclusively from Darwin. He first combats the view that the sexual elements play similar parts in reproduction, and the objection seems to be well taken; though, when he says that it cannot be shown that either sex may transmit *any* characteristic whatever, he pushes his objection too far, as is demonstrated by a multitude of facts in the breeding of domestic animals.

Having stated the theory, the author devotes a large part of his book to the evidence in its favor. From the study of hybrids he concludes that hybrids and mongrels are highly variable; that the children of hybrids are more variable than the hybrids themselves; and that, from the evidence of reciprocal crossing in the case of hybrids, variation is caused by the influence of the male. The evidence from variation is then considered, showing that variation is more common in sexual than in asexual reproduction (in plants at least); that changed conditions cause variation, not directly, but in subsequent generations; that specific characters are more variable than generic; that parts excessively developed in males are more variable than parts especially developed in females. Professor Brooks next takes up the very complex subject of secondary sexual characters, and shows from various kinds of evidence that the male is more variable than the female; and that the male has led the way in evolution, while the female has followed. One of the most important aspects of the hypothesis, the author considers to be the manner in which it removes objections to the theory of natural selection, by showing that large numbers of animals vary similarly and simultaneously, and so give an opportunity for natural selection to come into play.

Now, how far can this ingenious and ably supported hypothesis be regarded as a permanently valuable contribution to science? One great objection is apparent at the very outset, — that the author has not gone to nature for his facts, but has taken them almost entirely from Darwin's works, as he candidly says. This must necessarily impair the value of his conclusions. The whole work bears the stamp of being merely an ingenious attempt to supplement Darwin's hypotheses, and re-arrange his facts, and might have been written by one whose knowledge of biology had been drawn almost entirely from Darwin's books. The objection which Mr. Lewes[1] made to pangenesis holds equally well against this hypothesis. "The hypothesis is thus seen to be one wholly constructed out of suppositions, each and all of which may be erroneous, every one of them being necessary to the integrity of the scheme." Thus, the existence of gemmules is a supposition; that cells throw them off when disturbed is a supposition; that the male cell has acquired a special power of gathering and storing these germs is a supposition. Scarcely a single proposition of the hypothesis can be regarded as in any way proved. Then, again, some of the apparently simple assumptions really involve a number of others, equally without evidence. Thus, when it is said that the ovarian ova, being the direct descendants of the fertilized egg, inherit its peculiarities, we have no explanation offered for what is perhaps as great a mystery as the main problem itself. The ovarian ova are derived from the fertilized ovum through an immense number of intermediate cells, most of which become indifferent epithelium. We must, then, assume that the gemmules are all segregated together, and transmitted unchanged from cell to cell till they finally reach the ovarian ovum, — surely a very forced supposition.

The evidence by which Professor Brooks endeavors to support his hypothesis is by no means convincing: usually all that can be said of it is, that it does not contradict the view. In spite of his evident candor, the author has not always resisted the temptation of straining his points to the uttermost limit, often preferring a far-fetched and doubtful explanation to an obvious one close at hand, as in the cases of the zebra and niata hybrids on p. 130. The statement that the peculiarities of the niata breed of Paraguay cattle are probably due to a *reversion* to the type of Sivatherium will be an amusing one to paleontologists.

Then it is not at all clear, from the evidence presented, that this hypothesis will account more satisfactorily for the greater development of the male in those species in which the sexes differ than does Darwin's theory of sexual

[1] *Fortnightly review*, new series, vol. iv., p. 508.

selection: for, admitting Professor Brooks's doctrine, that each individual inherits *all* the characteristics of the species, and that the female function prevents the development of the male characters (though they may appear when that function is destroyed), it is plain that those characters are either incompatible with the female function or useless to the female, and hence there is no reason why she should acquire them; while their presence in the male, to which they are of obvious advantage, is in most cases to be accounted for by sexual selection. On the other hand, it is obvious that all the complex apparatus of uterus, placenta, and similar organs, must have originated with the female. We cannot agree with Professor Brooks, that the presence of mammae in the male is an indication that the mammary function was originally a male characteristic, any more than that the presence of rudimentary stridulating organs in female Orthoptera shows that these were first acquired by the female. Why should Professor Brooks adopt exactly opposite explanations for precisely parallel cases?

The propagation of cells by means of gemmules is not only purely hypothetical, but, apparently at least, opposed to what we know of the mode of cell-formation. Cells arise only by division of some pre-existing cell, and never seem to arise spontaneously, as would very probably be the case if their propagation by gemmules were at all common. Nor does the process of impregnation, as actually observed, lend support to the new hypothesis; for the head of the spermatozoon coalesces with the nucleus of the ovum, apparently without loss of bulk, or in any way indicating an emission of gemmules. The influence of the male element seems rather to consist in modifying the action of the egg-nucleus.

Mr. Conn's very obvious objection (given on p. 294), that in many cases unfavorable conditions would not act upon certain cells, causing them to emit gemmules, but would result in the destruction of the animal, seems entitled to more weight than the author is inclined to give it. Any hypothesis that fails to account for so large and important a class of facts cannot be called complete.

Want of space compels the omission of many other objections, as well as the consideration of Professor Brooks's views on reversion, natural selection, and the intellectual differences between men and women.

But, in spite of all that has been said, Professor Brooks is entitled to the thanks of all students of biology for his clear statement of the problem, and the many suggestive fields for investigation here opened. The student of heredity will find in this book just what he needs to give him a clear conception of how the problem is to be attacked. The book is one of remarkable ability. The way in which apparently disconnected series of phenomena are brought together and shown to be special cases of one general principle, is indeed masterly. Even if every single proposition of the hypothesis should prove to be without foundation, and the hypothesis entirely untenable, Professor Brooks must always be credited with having made a most important step in advance. Assuming that the problem of heredity is at all capable of solution, some such preliminary clearing of the field is a necessity. If different observers will devote their energies to following up the various lines of inquiry which Professor Brooks has so ably suggested, we may be sure of most valuable and fruitful additions to our knowledge. To use Mr. Lewes's words, "even should the hypothesis prove a will-o'-wisp, it is worth following if we follow circumspectly, for it hovers over lands where we may find valuable material. As an hypothesis, it so links together wide classes of facts that it may be a clew to great discoveries."

WATTS'S MANUAL OF CHEMISTRY.

A manual of chemistry, physical and inorganic. By HENRY WATTS. Philadelphia, *Blakiston*, 1884. 16+595 p. 8°.

FEW text-books of chemistry have been more successful than the 'Manual of elementary chemistry' first published in 1845 by Professor George Fownes. Fownes, who was but thirty years of age at the time, held the chair of chemistry in University college, London. His work had marked success from the very beginning, and he was called upon to prepare three editions in the succeeding four years. The third, however, appeared posthumously; for Fownes died in January, 1849, at the early age of thirty-four. Under the editorship of the late Dr. H. Bence Jones, and afterwards of Dr. A. W. Hofmann, the work appeared at frequent intervals in six editions; and, notwithstanding the constant additions of large amounts of new and important matter, the familiar name 'Fownes's chemistry' was retained. The tenth edition was edited by Dr. Bence Jones and Henry Watts, and appeared in 1868; another edition, by Henry Watts, followed in 1872; and finally a twelfth, greatly increased in size, and issued in two volumes devoted to inorganic

and organic chemistry respectively, completed in 1877 the long and valuable series.

The honorable career of this standard work reminds us of that other remarkable handbook, the '*Cours de chymie*' of Nicolas Lemery, of which the first edition appeared in 1675, and the fourteenth, greatly enlarged by Baron, in 1756, eighty-one years after.

The new work by Henry Watts is confessedly "founded on the well-known manual of chemistry of the late Professor Fownes;" and, such being its origin, we are not surprised to find that it wears the garb of a familiar friend. The learned editor of 'A dictionary of chemistry' has in this manual dropped the name 'Fownes' from the titlepage, and given us a revised edition bearing his own name. And this he undoubtedly has a right to do, if one takes into consideration the great alterations and additions made in the preceding editions with which his name was associated, together with the improvements in the one before us.

The present volume commences with a short sketch of the more important elementary bodies, the principal laws of chemical combination, the principles of nomenclature, and the representation of the constitution and reactions of bodies by symbolic notation. In the preceding edition (twelfth) of Fownes the three topics last named were treated at p. 123 of the volume: here they appear at p. 7.

This introduction is followed by a section on chemical physics which has always occupied a prominent place in the several editions of Fownes. The next section contains a description of the non-metallic elements in the following order: hydrogen, chlorine and its analogues, oxygen, sulphur and its analogues, nitrogen, phosphorus, arsenic, boron, silicon, and carbon. This is succeeded by a fuller consideration of the general principles of chemical philosophy, embracing sections on quantivalence, the periodic law, crystallization, and chemical affinity. At this point is introduced the subjects of electro-chemical decomposition, or electrolysis, and the chemistry of the voltaic pile, which are thus divorced from their rational connection with the chemical physics in the earlier portion of the work. The latter half of the volume treats of the metals in their usual systematic order.

Watts's chemistry, on the whole, differs more from its predecessor in the arrangement of material than in the introduction of novelties; still, we find new paragraphs here and there, embodying late discoveries. The work shows evidences of having been rather hastily prepared. Thus, while the newly announced elements, scandium, decipium, ytterbium, and samarium, are briefly described in their proper connection (pp. 458 to 463), only two of them (Sc and Yb) obtain positions in the list of elementary bodies on p. 3. Again: under oxygen we find no mention of its liquefaction, though in the section on chemical physics the experiments of Cailletet and Pictet are, far too briefly, chronicled. Ozone fares very badly, obtaining no recognition whatever in the body of the work, and being relegated to a single page (584) at the very close of the appendix; and there it is very inadequately treated. Its liquefaction by Hautefeuille and Chappuis is not mentioned. The page is a simple condensation of the two pages given to the subject in the preceding edition of Fownes, without the addition of a single new fact. The atomic weight of antimony still appears as 122, notwithstanding the great weight of evidence in favor of 120. Meyer and Seubert make Sb = 119.6.

The well-worn woodcuts, too familiar and never very attractive, still do service in illustration. The volume contains thirty-four pages more than the English edition of the last issue of Fownes. In spite of some blemishes, however, Watts's Chemistry sustains the high reputation of its lineal ancestor, and well deserves a large patronage.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Topographical work in North Carolina.—Party No. 1 of the Appalachian division was in charge of Mr. Charles M. Yeates, topographer, and, during the seasons of 1882 and 1883, surveyed the area lying between the Blue Ridge and the Tennessee line in North Carolina, with the exception of Watauga, Ashe, and Alleghany counties. This area lies between the 35th and 36th parallels, and extends from the 82d to the 84th degree of longitude, including the most mountainous portion of the state, and that which is usually designated as western North Carolina.

The state line separating North Carolina and Tennessee follows the summit of the Alleghany Range, which, in its different parts, has received various specific names; such as the 'Unaka,' the 'Bald,' and

the 'Smoky' Mountains. These names are applied to the portions that lie between terminal points where the rivers intersect it. Other local names have been applied to minor subdivisions and to summits; but the most prominent portions are known to the native population by names which agree with those used on the existing published maps of the region.

The Alleghany Range and the Blue Ridge are in general parallel to each other. The greatest distance between them is across Haywood and Transylvania counties, where they are fifty-five miles apart; while where they are closest they are only eight miles apart. They are also parallel with the coast-line; and a contour map of the state will show that it is crossed from south-west to north-east by a series of parallel ridges from a point within four miles of the coast to the Blue Ridge. The first of the ridges reaches an elevation of between seventy and eighty feet; and the succeeding ones increase in height, one after the other, until they culminate in the mountains of the western part of the state, where the general elevation is from 4,000 to 6,000 feet.

The Blue Ridge in this section is of peculiar interest, because in its details its course is very crooked. It is entirely unlike the long, straight ridges of eastern Tennessee. It enters the state from Virginia with an elevation of 4,000 feet above sea-level, and reaches its maximum height of about 6,000 feet at Grandfather Mountain, which is the highest summit in the ridge; although hitherto, High Pinnacle, near the Black Mountains, has enjoyed that reputation. The next highest point to the southward is Sugar Mountain, with an elevation of 5,200 feet. From the latter point the range drops to low summits, that do not usually exceed 3,600 feet above sea-level. These continue southward to Humpback Mountain, a distance of fifteen miles, when there is a rise to 4,800 feet; and from here to Bear Wallow Mountain the range is of a quite respectable elevation. At High Pinnacle, where the ridge joins the Black Mountains, the height is 5,600 feet. From Bear Wallow southward, the range is comparatively insignificant; but, as the state line is approached, it once more rises, and is of considerable importance as it passes from the state.

South and east of the Blue Ridge are the lowlands, while to the westward is the high plateau section. The difference in elevation between the two is generally about 1,000 feet in a distance of some two or three miles. The difference in seasons, between the two sections, is from two to three weeks. A view of the ridge from the west, at many points, would give an idea of insignificant elevation; whereas the same section, seen from the east, would be quite imposing. This peculiarity of the ridge is characteristic in North Carolina, with the exception of the section lying between Humpback Mountain and Sugar Mountain, in which the eastern and western descents are about equal.

North Carolina, west of the Blue Ridge, contains about 75,000 square miles, of which some 5,500 have already been surveyed, — 4,000 by Mr. Yeates's party, and 1,000 by Mr. Bien. The remaining portion will be surveyed by Mr. Yeates during the next season. The map will be on a scale of two miles to the inch, with contours two hundred feet apart vertically, which will show the country in considerable detail. The existing maps of the region have all been generalized, and are more or less indefinite.

The topographical features of the region are entirely dissimilar to those of the adjacent portions of Virginia and Tennessee. In the latter the strong orographical features of West Virginia and south-western Virginia gradually die out, while in North Carolina there appears to be no regular system when compared with the other states. The only resemblance is, that the Blue Ridge and the Alleghany Range are in general parallel with the ranges of East Tennessee. The distinctive topographical feature in North Carolina is the existence of cross-ranges which connect the Blue Ridge with the Alleghany Range, making immense drainage-basins, whose outlets are through the latter to the western river-systems. These cross-ranges, with the exception of the Great Smoky Mountains, are of more importance than the ranges which they connect; as they generally have a greater altitude, many of the summits reaching a height of more than 5,000 feet. The principal ones are the Rich Mountains, the Cockscomb Range, the Newfound Mountains, the Great Balsam Mountains, the Cowee Mountains, and the Nantehaleh Mountains. The Balsam Mountains share with the Smoky and Black Mountains of North Carolina, and the White Mountains of New Hampshire, the distinction of being the highest mountain masses in the eastern United States. The spurs of the cross-ranges form an intricate maze of drainage and topographical details.

The Black Mountains, a range ten miles in length, with seventeen summits, are neither one of the cross-ranges nor one of the transverse ranges, but a spur from the Blue Ridge, with which they are parallel. The highest point is Mitchell's High Peak, which is the highest summit east of the Rocky Mountains. Mr. Yeates, by barometrical measurement, obtained for it a height of 6,717 feet, which is six feet higher than any previous measurement. The coast and geodetic survey, by means of vertical angles, fixed its height at 6,688 feet above sea-level. The elevation given by Professor Guyot is 6,707 feet. Major James W. Wilson, chief engineer of the W. N. C. R.R., at the request of Gov. Swain of North Carolina, ascertained its height by means of levels, and fixed it at 6,711 feet.

The French Broad River is the principal stream of western North Carolina, and is a stream of much beauty, flowing through a valley of great fertility. Its course in the Transylvania valley is very sinuous, and its flow sluggish. The Indians designated this portion of its course 'sleeping serpent.' From Dunn's rock, a precipice that overlooks it, thirty-six bends can be counted as the river winds in its tortuous course through the farms in the valley below. Almost all the small streams, as well as the large rivers, of the section, have good water-powers, which must eventually be utilized for manufacturing purposes.

The timber-lands of the region form immense unbroken forests, exceptionally fine both as to density of growth and the character of the timber. Among the varieties of wood are maple, poplar, linden, balsam, cedar, hickory, ash, beech, birch, cherry, black walnut, and many varieties of oak. Some of the trees grow to an enormous size; and many men in this section, who a few years ago considered themselves poor because they possessed only a wilderness of forest, are beginning to realize that they are comparatively rich, the sale of a few individual trees frequently sufficing to give them an income for a considerable time. These trees are bought by speculators, who, in turn, sell them to other speculators, who may dispose of them to third parties, until finally a portable saw-mill is brought into the region, and the timber is prepared for market. A view from one of the cleared summits impresses one with the extent of the forests, which are, of course, broken here and there by many dots of cultivated land, both in the valleys and on the mountain sides. The country, however, is comparatively undeveloped. The soil is good, but farming is carried on in a primitive way and on a contracted scale. There is plenty of good grazing-land, and cattle are raised to a considerable extent. They are allowed to run wild among the mountain ridges; and the cost of keeping them is small, as they are allowed to find subsistence for themselves.

The mineral wealth of the region is well known. In fact, it has been said that almost every mineral or ore found within the limits of the United States can be found in North Carolina. The gold-mines east of the Blue Ridge have produced millions of dollars, notwithstanding the hinderances of swindlers and speculators. Mica-mining is one of the profitable industries of the region mapped by Mr. Yeates, and is carried on in nearly all of the counties west of the Blue Ridge. Kaoline and corundum mines are also worked, and a large deposit of talc is attracting considerable attention, while tin is the latest discovery.

PUBLIC AND PRIVATE INSTITUTIONS.

Peabody academy of science, Salem, Mass.

The director's trip to Japan. — Professor Morse left Salem early in the spring of 1882 for the purpose of visiting Japan and China, and reached Japan in May. On his arrival in that country he had several interviews with Mr. Kato, the director of the Imperial university, and told him that his time was to be divided between collecting ethnological material for the museum of the academy, and the study of ethnology and archeology, and specially the ceramic art. A suite of rooms in a little house near the astronomical observatory was fitted up for him by the university, and given to him free of cost during his entire stay. Rooms and closets in other college-buildings were given to him for storage purposes; and, indeed, every thing was done by the Japanese authorities to facilitate his work, without which assistance little progress could have been made in the task he had planned.

In return for the collections of corals sent out by the academy for the educational museum, the educational museum presented to the academy a large collection of tools illustrating the trades of Japan. Great credit is due Mr. Tejima, the director of the educational museum, for the thorough way in which this collection was brought together. Not only were the various implements collected; but in many cases partially completed specimens of the work, as well as colored sketches, accompanied the tools.

Through the influence of Dr. W. S. Bigelow, the academy is indebted for the remarkable collection of weapons which were presented by a famous sword-merchant, Mr. Machida Heikichi. Having explained to Mr. Machida the objects of the academy, and the nature of its museum, Mr. Machida, with great pains, and at his own expense, brought together the invaluable collection of swords, spears, bows and arrows, and other weapons which now enrich the academy's museum, and presented them outright, properly labelled and prepared for shipment.

Mr. Takanaka Hachitaro supplied the Japanese names for all the objects collected. He also presented many objects of household use, and clothing. Professor Mitsukuri, at great trouble, sought out the proper person to whom was intrusted the making of the large figures which now adorn the museum, and personally superintended their dressing and arrangement.

Korean collections. — Through Capt. Hammond Professor Morse was made acquainted with Count von Mollendorff, then on his way to Korea as special commissioner for China. He authorized him to spend a limited sum for purchases of ethnological materials in that country, and gave him a brief list of desirable objects. The results of his work, filling four cases, have already been received and unpacked. They arrived in fair condition; and as far as he knows, this is the first collection of Korean objects ever sent from that country. In this connection it is proper to mention, that members of the Korean embassy who visited this country last year presented a number of objects to the academy; and one of their suite, Mr. Yu Kil Chun, who remained in this country, and who is now living in Salem, presented his entire suit of clothing, and other objects, to the museum.

Accessions to the museum. — These have been more numerous and more valuable than during any year, perhaps, since the foundation of the East India marine collection in 1799. The principal ones are as follows: —

Morse collection, Japan, 680 numbers; Morse collection, elsewhere, 141; William Dolan, China, 50 specimens. Additions to county collections: plants, 54; mammals, 50; and archeology (85 lots), 322 specimens (this last includes about 15 lots, 50 specimens outside); botanical, 200; other accessions, 300; models of boats, 12.

Visitors to the museum. — Thirty-six thousand and fifty-six persons have visited the museum during the year. The greatest numbers on single days were: Feb. 22, 440; July 4, 182; April 5 (Fast), 346; Sept. 25 (first day of cattle-show), 384; Sept. 26 (second day of cattle-show), 936; Nov. 29 (Thanksgiving),

336. July 4 is mentioned to show how few persons are often at the museum on holidays now, as compared with the attendance on such days in former years, especially in summer, when 'attractions' are offered at the 'Willows,' 'Point of Pines,' and other popular resorts in the neighborhood.

The above figures are undoubtedly under the actual numbers. There is a steady increase, each year of late, in the regular daily attendance, and a corresponding decrease on popular holidays.

The specimens which seem to be of most interest to the general public are the life-size figures from China, Japan, India, and other countries; the general collection of mammals and birds; the Essex county animals and woods; and, perhaps more than any thing else, the human skeletons and crania. The carving 'Heaven and the day of judgment' of course holds the first place for the seeker after the curious and wonderful.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Ottawa field-naturalists' club, Canada.

March 13. — Mr. W. P. Lett read a paper on the deer of the Ottawa valley. Of these, the most important as regards size is the moose, or American elk (Alce americanus), which unfortunately, owing to indiscriminate slaughter and illegal hunting, is rapidly becoming very rare, except in remote districts along the northern tributaries of the Ottawa. The woodland caribou, or reindeer (Rangifer caribou), formerly frequented the whole country on the north side of the river, but was only an occasional straggler on the opposite shore. Like the moose, it has been driven northward, and much diminished in numbers, although sometimes still found on the Des Licores River, fifty or sixty miles from its mouth, on the upper Gatineau, and to the north of Lake Nippissing. It is the swiftest and wildest of all deer; and the only successful method of capturing it is by still-hunting. The magnificent wapiti, or great stag (Cervus canadensis), falsely called the American elk, was, within the memory of persons still living, an inhabitant of the great hardwood forests along the Ottawa, and was seen within four miles of the spot where the city now is. Fragments of its enormous antlers are still turned up by the plough in various localities, but the stately monarch of the forest has retired to the far northwest territories. The common red or Virginian deer (Coriacus virginianus) is still found within a few miles of Ottawa, but owing to pot-hunting and slaughtering during the winter, when the snow is deep, is becoming annually less plentiful. Not many years ago immense yards, containing hundreds of deer, existed along the various tributaries; but, except in remote districts, the yards are now scattered and small, and the deer confined chiefly to the large swamps. Reference was made by the lecturer to the variety of this species known as the 'spikehorn,' and to interesting piebald and white specimens which had been observed by him. A fine collection of heads and antlers of the several species was shown, including some abnormal antlers from old red bucks.

Society of arts, Boston.

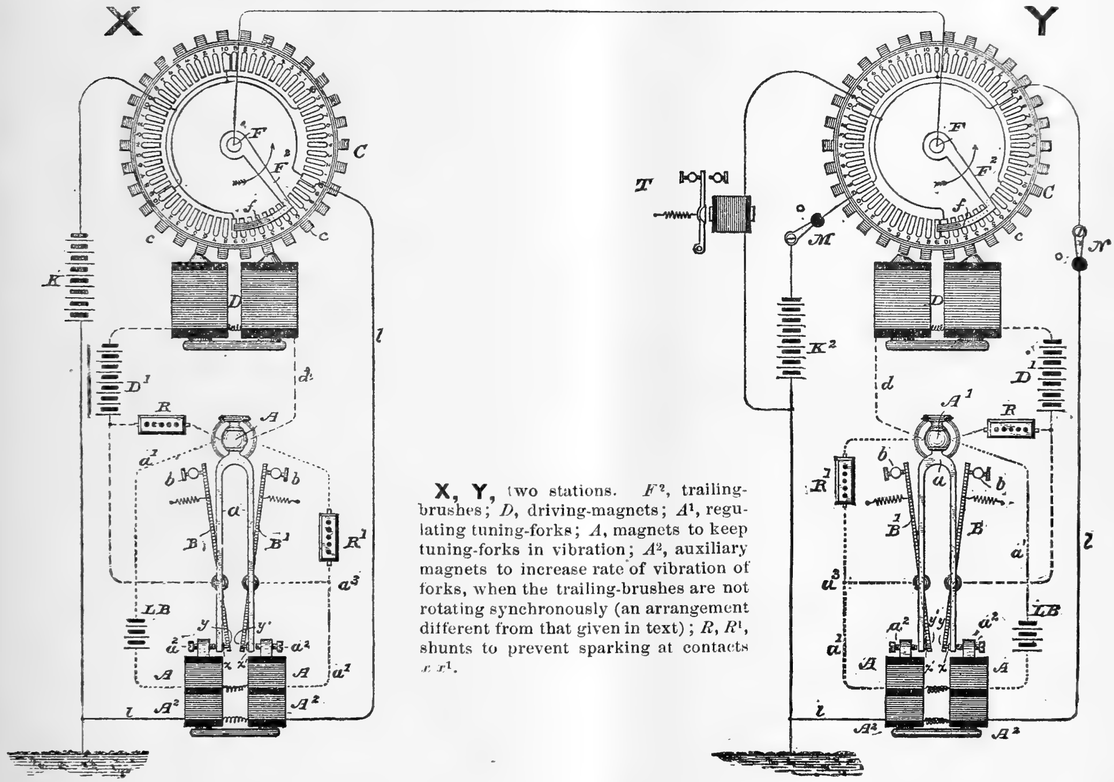
March 13. — Mr. P. B. Delany of New York gave the first public exhibition and description of his new system of synchronous, multiplex telegraphy, — the result of inventions by Mr. P. La Cour (1878), Mr. E. A. Callahan of New York, and himself (1883). By this system any number, up to twelve, of fast Morse circuits can be simultaneously worked over a single wire, the messages going in either direction on any circuit; also a greater number of slow Morse circuits, and as many as seventy-two printing-circuits.

At each end of the main line a drum, called a distributer, is maintained in uniform rotation about a vertical axis by the intermittent attraction of an electro-magnet on the toothed circumference of a horizontal circular plate carried by the drum. A tuning-fork, vibrated electrically (about eighty-five vibrations), opens the motor circuit at each vibration, and thus produces the intermittence in the motor magnet driving the distributer. If the forks at either end of the line were in absolute unison, and the toothed circumference had the same number of teeth each, the drums would rotate synchronously. The impossibility of absolute and continued unison is met by automatic regulation of the rate of the forks, the principle involved being an automatic shunting of a resistance-coil which is normally in the circuit driving the fork; thus increasing the current in that circuit, and hence amplifying the excursion of the prongs, intensifying the field of magnetic force in which this vibration occurs, and thus diminishing (by even five per cent) the rate of the fork. This slowing-down of the fork would immediately result in a corresponding lessening of the speed of rotation of the distributer at that end of the line.

The main principle of the multiplex use of the single line consists in giving the line synchronously, and in sufficiently rapid succession, to the corresponding instruments or circuits at the opposite ends of the line. In the apparatus shown, the rotating drum or distributer carried a brush which trailed over a circular series of eighty-four narrow, insulated, radial plates or segments of metal. Of these, twelve were utilized for the synchronizing arrangement, and the remaining seventy-two were divided among six circuits; the terminus of the same circuit being thus connected to twelve equi-distant segments, each circuit containing merely the ordinary polarized relay, reversing key and ground; the relay serving to close the local circuit through a sounder, as usual. Thus, when the brushes at both ends of the line make contact at the same instant with any one of the twelve segments of the same circuit, that circuit, and no

other, can be in operation. As the synchronous rotation continues, each circuit will be in turn closed through the single main-line wire in succession, and each twelve times in a rotation, and thirty-four times in a second. The frequency of successive closings of the same circuit is thus so great, that, in the fast-working Morse instrument, one closing at least will occur in even the shortest signal, so that no dot can be missed.

The automatic synchronizing device consists in having three equi-distant segments in each set about twice as broad as the others, the segment next preceding each of these being idle. The relative positions of these broad segments are not the same in the two sets; but, in the position corresponding to every broad segment of either set, there is, in the other set, an ordinary narrow segment connected with a grounded battery (the same battery serving, of course, for all three segments of each set). The broad segments are all grounded. The two distributers will be synchronous when the brush of one is on any one of its narrow-battery segments at the same instant that the brush of the other is on the idle segment next preceding the broad one. If the synchronism is perfect, both brushes will pass off these segments at the same instant. If, however, the brush on the idle segment is ahead of such a synchronous position, it will pass on to the broad segment while yet the other brush is on the narrow-battery segment: a current through the line and broad-segment contact to ground will ensue. This current excites a relay (located between the broad segment and the ground), which opens a local relay circuit (normally closed). As the armature of this second relay comes sharply to its back-stop, it short-circuits the resistance-coil previously alluded to as being in the circuit of the fork-driving battery, and thus effects a slowing-down of the fork and distributer, as before described. As there are three broad segments to be touched in each revolution, this synchronizing pulse may be sent thrice, twice, once, or not at all, as may be necessary, in either direction during each revolution. The two distributers may thus be kept within one-quarter of the width of the narrow segments of each other; this corresponding to a synchronism of about 0.001 of a second, or about 0.002 of a revolution.



X, Y, two stations. F^2, trailing-brushes; D, driving-magnets; A^1, regulating tuning-forks; A, magnets to keep tuning-forks in vibration; A^2, auxiliary magnets to increase rate of vibration of forks, when the trailing-brushes are not rotating synchronously (an arrangement different from that given in text); R, R^1, shunts to prevent sparking at contacts x x^1.

Trenton natural history society.

March 11. — W. S. Lee remarked on New Jersey as a paradise for the botanist, particularly commending the region about Trenton as one rich in rarities of plant-life. A certain hillside sloping to the south presents many spring flowers two weeks earlier than similar locations in even the same state; and several rare species grow there, among others Corydalis aurea and C. flavula. Other rare New-Jersey species mentioned as found near Trenton were Fedia olitoria, Ellisia nyctelea, Onopordon acanthium, Potentilla

argentea, Viola striata, and Cornus canadensis. —— Dr. T. S. Stevens exhibited a little garter-snake (Eutaenia sirtalis) preserved by nature in an interesting manner. It had been taken from beneath a wheat-stack in its present condition, the body thrown in graceful coils and curves, the head erect, the whole appearing like a snake on the alert, yet dead, perfectly dry and mummy-like, and presenting only the slightest changes externally. According to Dr. Stevens, it has remained in this condition, without any special attention, for ten years.

Academy of natural sciences, Philadelphia.

March 4. — Professor Joseph Leidy stated that he had recently been supplied with specimens of a wheel-less rotifer, attributed to Apsilus, which had been found abundantly last autumn, in a pond at Fairmount Park, attached to Anacharis, and in the Schuylkill River, near by, attached to Potamogeton. They were recognized as Dictyophora, first described in 1857; and as a result of the last examination, Professor Leidy was led to the opinion, that this form, the Apsilus lentiformis of Mecznichow, the Capelopagus lucinedax of Forbes, and the Apsilus bipera recently described by Miss Foulke, are all the same species. In the recent specimens, he had recognized the lateral antennae ending in exceedingly delicate and motionless cilia, as indicated by Mecznichow, and which previously, from the wrinkled condition of the specimens detached from hard objects, had escaped his attention. In all the forms described, the prehensile cup, in the same manner, is projected from, and withdrawn within, the mouth of a compressed oval or nearly spherical carapace, dotted with minute tubercles. This cup, substituting the usual rotary organs of rotifers, communicates with a capacious, variably sacculated, and dilatable stomach, followed by the ordinary gizzard with its mastax, and then a second sacculated stomach. The size of the European forms is fully thrice that of the one now described. —— Miss S. G. Foulke described a species of ciliated infusorian of the genus Trachelius, found in the form of a white speck in water from the Schuylkill River. —— Rev. Dr. H. C. McCook, referring to the spinning-work of spiders, stated that the orb-weavers have, as a rule, but one egg-nest; but this, in the different species, varies widely in form, size, position, etc. There are, however, four species which make several cocoons in connection with their webs. The labyrinth spider, Epeira labyrinthica, weaves a web of right lines crossing at all angles above the orb-web. In the midst of these right lines the spider lives, almost always under a dried leaf. Under the leaf is a little white silk tent or belt-shaped nest connected with the web by a trap-line. Hanging above the tent are nearly always five cocoons, braced above and below by a strong silken line. They consist of a lower cup portion, covered by a sort of lid, and each contains about twenty eggs. The tailed spider, Cyrtophora caudata, generally makes five nests, containing in the aggregate a hundred or a hundred and twenty-five eggs. These are strung along the median line of the orb-web. They are at first composed of a yellowish, slightly viscid plush, and are afterwards covered with fragments of captured insects. This may be an instance of protective mimicry, as the cocoons so covered closely resemble the spider itself; or it may be due to the maternal impulse to protect the repositories of the young as far as possible. Epeira basilica, which forms a beautiful dome-like web placed over a silken sheet, suspends its cocoons vertically in the centre of the snare. They consist of a dusky gray silken sac, within which is a hard ball like a cherry-stone. This ball is quite black, but proves, when placed under a microscope and illuminated, to be woven of a fine-textured yellow silk. It is filled with finely chopped silk, in which the young spiders are hatched. Uloborus riparia makes a horizontal web, the cocoons being strung horizontally from the centre. They are double cones, covered with little protective points.

Mathematical section, philosophical society, Washington.

Jan. 30. — Mr. G. K. Gilbert made a communication on the Knight's tour, on other fields than those of sixty-four squares. He showed that a complete tour was impossible if the number of squares was odd; that a tour having *bilateral* symmetry (latter half of the moves symmetrical with former half, with respect to a line through the centre of the field) was impossible if the number of squares was divisible by four, and hence altogether impossible on square fields; that a tour having *quadri-radial* symmetry (divisible into four parts, which exactly repeat themselves when the board is turned through a right angle about the centre of figure) was impossible if the number of squares was divisible by eight; that the only symmetry possible on the ordinary chess-board was therefore *bi-radial* (of two parts that coincide when the board is turned through two right angles). Upon a field of thirty-six squares, twenty tours with bi-radial symmetry are possible: of these, five have also quadri-radial symmetry.

NOTES AND NEWS.

THE following communication, kindly placed in our hands by the committee on invitations and receptions of the Philadelphia meeting of the American association, will interest the members of the association: —

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,
22 ALBEMARLE STREET, LONDON, W.,
Feb. 27, 1884.

DEAR SIR, — The resolution of the American association, inviting members of our association to visit Philadelphia and take part in its meeting, was read to our general committee by Principal Dawson, and was received with enthusiasm. No definite resolution in reply was, however, proposed; because it was felt that the visit to Canada was only then assuming definiteness as to its outlines, and it was impossible to say what arrangements might be made in that country. But the members of the association were fully sensible of the courtesy and kindness of their American brethren; and the enclosed resolution, which was passed by the council at their last meeting,

and which I should have forwarded to the secretary of the American association as soon as the minutes had been confirmed, will, I hope, be regarded as a reply from our association.

The kind invitation repeated in your letter shall be embodied in a circular which we are about to issue to our members. I fear that at present it will be impossible for me to give you any idea of what number of our members will be able to avail themselves of the hospitality offered by your committee at Philadelphia, because at present only the bare outlines of the proposed proceedings at Montreal and in Canada are before them. When the immediate pressure of the issue of this circular is over, I will do my best to find out.

Very truly yours,
T. G. BONNEY, *secretary*.

Dr. P. FRAZER, *secretary*.

The resolution mentioned reads, —

"It was resolved to receive the standing committee and fellows of the American association on the footing of honorary members at the Montreal meeting, and the secretary was instructed to give intimation of this resolution, as far as possible, to the persons concerned."

Another letter just received from Professor Bonney encloses two circulars, — one containing a reprint of the resolution above referred to, and an invitation to the person to whom it is sent to attend the meeting in Montreal; stating, that, on its presentation to the secretary on or after Aug. 25, a ticket of honorary membership will be received in exchange: the other circular is an admirable condensation of such information as the British member is likely to need. Thus, the first two pages are devoted to the steamer-lines and the fares thereon; three pages are concerned with the railways; and it may be mentioned in this connection, that the Canadian government has promised to convey all British association members, associates, and their family parties, free of charge. The Canada Pacific and the Canada Atlantic offer them free excursions, the former granting free passes up to the date of their special free excursion to the Rocky Mountains (for a hundred and fifty only). The remaining pages give general information as to 'tickets,' 'local committees,' 'general instructions,' 'hotel rates,' 'telegraphs,' and 'cash.' The last page is a very convenient schedule, giving the various railways, the points between which they run, the distance in miles, and the rates in English and United States money. The passage which most interests the members of the American association is as follows: "A letter has been received from the representatives of the local committee at Philadelphia, cordially inviting the members of the British association to attend this meeting and take part in its scientific proceedings, and offering to do the utmost in their power to make their visit at once pleasant and profitable."

— From *Nature* we learn that the officers of the British association at the Montreal meeting will be as follows: president, Lord Rayleigh; vice-presidents, the governor-general of Canada, Sir John Alexander Macdonald, Sir Lyon Playfair, Sir Alexander Tilloch Galt, Sir Charles Tupper, Sir Narcisse Dorion, Dr. Chauveau, Principal J. W. Dawson, Professor Edward Frankland, W. H. Hingston, Thomas Sterry Hunt; general treasurer, Prof. A. W. Williamson; general secretaries, Capt. Douglas Galton, A. G. Vernon Harcourt; secretary, Prof. T. G. Bonney; local secretaries, L. E. Dawson, R. A. Ramsay, S. Rivard, S. C. Stevenson, Thomas White; local treasurer, F. Wolferstan Thomas. The sections are the following: — **A**, Mathematical and physical science: president, Sir William Thomson; vice-presidents, Prof. J. B. Cherriman, J. W. L. Glaisher; secretaries, Charles H. Carpmael, Prof. A. Johnson, Prof. O. J. Lodge, D. MacAlister (recorder). **B**, Chemical science: president, Prof. H. E. Roscoe; vice-presidents, Professor Dewar, Prof. B. J. Harrington; secretaries, Prof. P. Phillips Bedson (recorder), H. B. Dixon, T. McFarlane, Prof. W. W. Pike. **C**, Geology: president, W. T. Blanford; vice-presidents, Professor Rupert Jones, A. R. C. Selwyn; secretaries, F. Adams, G. M. Dawson, W. Topley (recorder), W. Whitaker. **D**, Biology: president, Prof. H. N. Moseley; vice-presidents, Dr. W. B. Carpenter, Prof. R. G. Lawson; secretaries, Prof. W. Osler, Howard Saunders (recorder), A. Sedgwick, Prof. R. Ramsay Wright. **E**, Geography: vice-presidents, Col. Rhodes, P. L. Sclater; secretaries, R. Bell, Rev. Abbé Laflamme, E. G. Ravenstein, E. C. Rye (recorder). **F**, Economic science and statistics: president, Sir R. Temple; vice-presidents, J. B. Martin, Prof. J. Clark Murray; secretaries, Prof. H. S. Foxwell, J. S. McLennan, Constantine Molloy (recorder), Prof. J. Watson. **G**, Mechanical science: president, Sir F. J. Bramwell; vice-presidents, Prof. H. T. Bovey, P. G. B. Westmacott; secretaries, A. T. Atchison, J. Kennedy, L. Lesage, H. T. Wood (recorder). **H**, Anthropology: president, Prof. E. B. Tylor; vice-presidents, Prof. W. Boyd Dawkins, Professor Daniel Wilson; secretaries, G. W. Bloxam (recorder), Rev. J. Campbell, Walter Hurst, J. M. P. Lemoine.

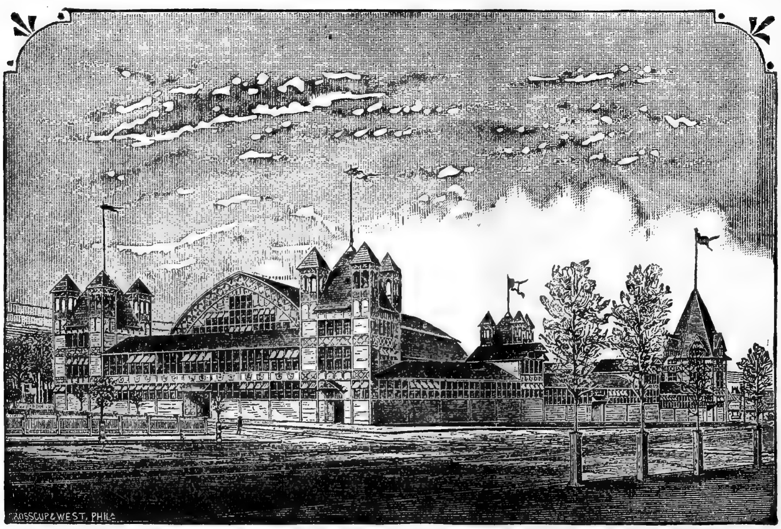
It is expected that the public lectures will be by Mr. Crookes, Dr. Dallinger, and Professor Ball. We are glad to see that Section A is following the good example set by Professor Lankester in biology last year. A circular signed by Sir William Thomson has been issued by the committee of Section A, inviting the co-operation of mathematicians and physicists, and requesting those willing to read papers and take part in the discussions to send their names to the secretaries of Section A, British association, Albemarle Street, London. The following subjects have been selected for special discussion by the committee: on Friday, Aug. 29, The seat of the electromotive forces in the voltaic cell; on Monday, Sept. 1, The connection of sun-spots with terrestrial phenomena.

— At the meeting of the Royal astronomical society, Nov. 9, Prof. S. P. Langley of Allegheny, Penn., Dr. J. A. C. Oudemans of Utrecht, Netherlands, Prof. P. Tacchini of Rome, and Dr. E. Weiss

of Vienna, were elected foreign associates of the society.

— The committee of the Franklin institute, having in charge the organization of the electrical exhibition to be held in Philadelphia, has secured a site for the building on the large vacant lot bounded by Thirty-second and Thirty-third Streets, Lancaster Avenue, and Foster Street, which, by the liberal action of the Pennsylvania railroad company, has been leased to the institute for the purpose of the exhibition for a nominal consideration.

The meeting of the American association for the advancement of science, which will be held this year in Philadelphia, and the expected presence of many representatives of the British association, which will meet this year in Montreal, will attract a numerous and influential scientific gathering in Philadelphia during the time of holding of the exhibition; and, in order that so exceptional an opportunity to promote the interests of science shall not be lost, Congress has been requested to authorize the holding of a national conference of electricians, to convene in Philadelphia at that time. Should Congress make the proper provisions for holding such a conference, the results promise to be of much value.



The accompanying figure is a view of the exhibition building, which is now in process of erection, and which, by the terms of the contract, will be finished by the 15th of June.

The main building will be rectangular, having a length of two hundred and eighty-three feet, and a breadth of a hundred and sixty feet. A tower sixty feet high will be situated at each of the four corners of this building. One central arch of a hundred feet span, and two hundred feet in length, will cover the greater portion of the space occupied by this building; while two smaller ones, having a span of thirty feet, and running parallel to it on either side, will join the towers. The building will have second-story apartments at its ends, with stairways leading up in the towers from the ground floor. The towers themselves will be three stories high. Two long and narrow hall-ways will afford communication between these apartments. The remainder of the ground will be enclosed by a large triangular building one story in height, and joined to the main hall.

The circular of information, with blank forms of application for space, may be obtained by addressing a request therefor to the secretary of the Franklin institute.

— It is proposed to establish a monthly *American meteorological journal.* It will begin with from twenty-four to thirty-two octavo pages, and will be enlarged as rapidly as is justified by the support given it. The first number will probably appear about the 1st of May. It will be published in Detroit by Dr. W. H. Burr. The editing will be in the hands of Prof. M. W. Harrington of Ann Arbor, and he earnestly requests contributions from meteorologists. The publication price is placed at three dollars. All communications of a business character are to be addressed to W. H. Burr & Co., 100 Griswold Street, Detroit, Mich.; all others, to Prof. M. W. Harrington, Ann Arbor, Mich.

— The funeral of the late Dr. J. F. Julius Schmidt, director of the observatory at Athens, was of a public character, and the king and queen of Greece were present at the observatory during the delivery of the oration.

— The German geographical congress will be held in Munich from the 17th to the 19th of April. The principal subjects of discussion will be, the present situation of polar research, the latest proposals for the alteration of the meridian, the glacial period, and the making of school wall-maps. Several well-known travellers and investigators have already promised to speak.

— An international ornithological congress will be held for the first time in Vienna on April 7; and an exhibition of birds, and all that concerns their capture, transport, housing, and feeding, will be open April 4 to 14. The subjects for discussion at the congress will be, (1) a proposal for an international bird-protection act; (2) the origin of the domestic fowl, and the best means of improving the species; and (3) the foundation of stations for ornithological observations all over the inhabitable world. Communications should be addressed to Dr. Gustav von Hayek, 3 Marokkanergasse, Vienna.

SCIENCE.

FRIDAY, APRIL 4, 1884.

COMMENT AND CRITICISM.

Two bills are before Congress for the better administration of the naval observatory. One places the control of the observatory in the hands of a board, under the secretary of the navy, consisting of the superintendent, the senior line officer attached to the observatory, and the four senior professors of mathematics actually engaged in astronomical work at the observatory: the other is intended to give the positions of assistant astronomers that attraction in the way of promise of promotion necessary to induce young men to enter on the work, looking upon it as a permanency, and not as a make-shift till something better may turn up. It appears that in the past twenty-two years, from the corps of three assistant astronomers, there have been eleven resignations and only four promotions, and of the latter only one in the last nineteen years. It would seem that these bills are both in the direction of placing the working of the observatory on a more permanent footing, and of making it less subject to interruption from changes in the corps of observers, as well as a step towards giving the direction of the scientific work of the institution into the hands of those capable of making it tell better than in the past.

A RECENT statistical inquiry into the working of the system of German universities during the last half-century, is a model of painstaking research and accuracy. The author is Dr. I. Conrad of Halle, well known as a professor of political science; and the volume before us is the fifteenth paper in a series of studies produced, under his direction, by the seminary at Halle, of which he is the director. We might almost as well endeavor to cull interesting facts from a volume of the census as to draw from these pages, crowded with statistical tables, and illustrated by numerous diagrams, examples of the important and curious lessons brought out by this study. One fact, however, is so patent, and is such an index of the social condition of Germany, that it is worth mentioning. During the last thirty years the attendance on the seven universities of old Prussia has enormously increased, and especially since 1874, when there was a brief temporary retrograde. All the faculties, except that of Roman-catholic theology, show this increase; but that of philosophy has gained far the most, as might indeed be surmised from the growth of modern departments of scientific instruction. In all the universities of Germany, similar progress may be seen. In the decade prior to 1850 (the period of 1848) there was a diminution in the aggregate attendance; in the next two decades there was a slight increase: but since 1870 the number of students has rapidly augmented. Philosophy has gained most, law next, medicine next, and then protestant theology. Catholic theology alone has less followers in these institutions than it had twenty years ago. A summary carefully prepared, of these two hundred and fifty pages, would make an excellent contribution to an American journal of education. A kindred study of the attendance upon American colleges, such as Dr. Barnard of Columbia college initiated a few years ago, would make an admirable basis for the inquiries now in progress as to possible improvements in our institutions of learning. Is there not some agency in this country by which this investigation may be promoted?

THERE has not yet appeared any good and trustworthy illustration of a tornado at work, in spite of the comparatively common occurrence of these storms within sight of many observers. This is natural enough, to be sure; for in addition to the difficulty of the subject,

as may be inferred from the generally poor representation of clouds in woodcuts and other illustrations, there must be quite enough besides sketching to occupy one's mind while a tornado is sweeping past. But now that Mr. Finley has shown that a tornado will almost certainly be harmless when seen in the southeast, is it too much to hope that some well-trained, artistic, and self-possessed observer may secure drawings of the swinging funnel-cloud in its several phases, from which finished and characteristic illustrations can be made at leisure afterwards? A house or tree of known height, and at known distance, would give a unit of angular measure from which the altitude and diameter of the funnel could be determined after the distance to the ordinarily well-marked track is discovered. We should be indeed very glad, if the coming summer were to pass by without visits from tornadoes; but if they come, as is most likely, let as much be found out about them as possible. Water-spouts are in the same need of good portraiture, and an observant voyager in equatorial seas can do good service by bringing home accurate pictures of them. Is there not here a good opportunity for the numerous amateur photographers to turn their experimentation to good purpose? A series of instantaneous photographs would be especially interesting?

A new motor is said to have been brought out in New-York City, that hot-bed of schemes for making money out of the unwary. It is a new form of bisulphide-of-carbon engine, this time, which is to revolutionize the world, and the stock of which is offered for sale, to the fortunate who are admitted to the 'ground-floor,' at prices enormously below its real value, giving an opportunity to those favored ones to make the 'millions' that are undoubtedly in it. We are told of a triple thermic motor which is operated by the odorous fluid, and which is expected by the enthusiastic believers in the wonderful invention to give "three times as much power from a steam-boiler used to evaporate the vapor as could be obtained from the same boiler by means of a steam-engine." It is said that large sums have been paid for the stock of the new company operating this machine by the ignorant capitalist, who, sharp as he is when 'working his points' in Wall Street, — not having even the intelligence of the man who acted as his own lawyer, and seldom thinking of consulting an engineer of known integrity and good professional standing, in a matter which demands at least the rudiments of an ordinary scientific training, — is often gulled with startling ease by the venders of 'Keeley motors,' and promoters of similar schemes.

The hydrographic office of our navy department has lately issued the first numbers of a set of monthly meteorological charts of the North Atlantic, containing the results of many thousand observations on the winds and other atmospheric phenomena in form for giving practical information to the navigator. These are not to be confounded with the monthly pilot-charts begun in December last, of which mention has already been made in our columns, but are vastly more thorough. Indeed, the two series have about the relation to each other that weather has to climate. One is designed chiefly to spread information concerning recent changes in lights, buoys, etc., and to gather and record temporary conditions of the ocean: the other aims to give in detail the average and consequently permanent elements of maritime meteorology for every five degrees square of the ocean and for every month. The charts now published are for March, April, and May: the rest of the set will probably follow in the course of the year. Every one interested in the growth of our mercantile marine, as well as in the improvement of our navy, must rejoice to see this action of the hydrographic office toward the maintenance of the wide reputation for meteorological work on the ocean, well earned in Lieut. Maury's time; and we trust that the series of charts now begun for the North Atlantic may be followed by others of equal detail for the other oceans, towards which a great amount of available material has been accumulated.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The great comet of September, 1882.

A MORE recent determination of the orbit of this comet than those mentioned in No. 57 of *Science* has been made, and the results may be of interest. To avoid (as far as may be) the errors which arise from the fact that different observers have observed various portions of the nucleus, it was thought best to take a series of observations made at a single observatory. A fine series of over one hundred observations made at Cordoba, and extending from Oct. 17, 1882, to June 1, 1883, was chosen. Up to Feb. 12, the same portion of the nucleus was observed: this portion afterwards became invisible, and then the estimated centre of the elongated nebulous mass was taken.

By comparing these observations with an ephemeris computed from a former orbit, three normal places were found, the four observations made in May and June being neglected. The dates of these normal places were Nov. 16.0, Jan. 3.0, and March 25.0. It is to be regretted that these observations did not begin in September, so that the first normal place might have been nearer the time of perihelion. Below is the derived system of elements, which is referred to the mean equinox of 1883.0, Greenwich M.T.

T	Sept. 17.2637		
π	55°	2′	16 59″
Ω	345	43	55.01
i	141	54	31.54
ϕ	89	13	55.8
log e	9.9999610		
log q	7.8821773		
log a	1.9289		
Period	782.4 years.		
Perihelion distance	707,500 miles.		
Semi-major axis	7,878,000,000 "		
Semi-minor axis	105,600,000 "		

These elements satisfy the second normal place very closely, the residuals being —

$$\Delta \lambda \cos \beta = + 0.02''; \Delta \beta = + 0.02''.$$

If the period be assumed as 751 years, on the assumption that the comet appeared in 370 B.C. and 1132 A.D., and the foregoing perihelion distance be accepted, the logarithm of the eccentricity must be 9.9999599, which is 0.0000011 less than the value given above.

It is the intention of the writer to combine all the reliable observations which have been made, in the hope of obtaining a fair orbit for this perplexing object. H. A. HOWE.

University of Denver,
March 11.

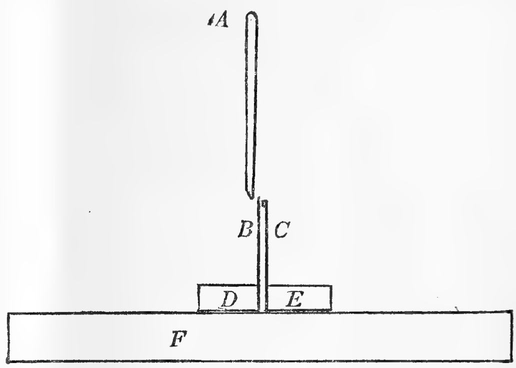
Atmospheric wave from Krakatoa.

Granting, as stated in *Science*, iii. 338, that an atmospheric wave passing over the entire world was caused by the great eruption in the Straits of Sunda, would not its greatest effect be observable at the opposite extremity of the diameter of the earth, or near the northern extremity of South America? The wave would doubtless pass away from its origin in all conceivable directions, its front forming the arc of a small circle, constantly enlarging until it became a great circle, after which it would contract, converging as to a focus on the opposite side of the earth, producing a magnified effect; after which it would return as from a second origin. W.

Hoboken, March 16.

Electric time-signals.

The devices, recently described in *Science*, by which a clock is made to close an electric circuit at regular intervals, prompt me to describe a very simple one which I have found entirely satisfactory. It is applied to a tower-clock as follows: to the arbor carrying the minute-hand, at the end A, opposite the dial, is screwed a slender brass arm about five inches in length, extending down to two light metallic springs, B C. The brass arm at the proper moment comes in contact with B, and moves it forward till it touches



the platinum point on C. The electric circuit is then closed, as B and C are soldered to two brass blocks, D E, to which the wires of the circuit are attached. These blocks are screwed fast to a piece of wood, F, which is in turn secured to the clock-frame by set screws. It will be observed that the current does not pass through the works of the clock. The appliance can be made to close the circuit at any portion of the hour by simply loosening the movable hand at A, and fastening it so that it shall bring the two springs together at the required minute. This arrangement has not failed once in a year and a half on a circuit including nine bells. H. S. CARHART.

Evanston, Ill., March 17.

Is material contact possible?

Dr. John Robison, the eminent Scottish physicist, discussing 'Newton's rings' (about 1795), concluded that to produce the central 'black spot' between two glasses required a pressure of about a thousand pounds to a square inch; the separation at this place being still about $\frac{1}{250000}$ of an inch. Dr. Thomas Young (about 1805) found that the phenomenon does not depend on the presence of air. By the general consensus of physicists this has been accepted as a striking evidence that molecular resistance to absolute contact is insuperable.

Sir William Thomson, in a Friday evening lecture at the Royal institution of Great Britain, delivered Feb. 2, 1883, said, however, very emphatically, "I do not believe that for a moment. The seeming repulsion comes from *shreds or particles of dust between them*" (*Proc. Roy. inst.*, Feb. 2, 1883, x. 189; *Nature*, June 28, 1883).

As a question of fact, this is one of very great importance; and it surely deserves a critical and decisive determination by some of our well-equipped physicists. The investigation, though a very delicate and refined one, is quite within the resources of modern experimentation. The physical problem is, can the 'black spot' between perfectly clean plates be produced without sensible pressure? W. B. T.

High tides in geological history.

In the review of the *Geographisches jahrbuch* for 1882, published in *Science*, No. 54, the notice of the contribution of Dr. Zöppritz on the progress of terrestrial physics contains the following words: —

> "In commenting on Professor George Darwin's work on the effect of the tides upon the moon's distance, and on Mr. Ball's entertaining lecture, 'A glimpse through the corridors of time,' on the same subject, the reviewer accepts Professor Newberry's conclusion, that the moon must have already attained its actual distance from us when our oldest Cambrian and Silurian strata were deposited. This seems an unnecessary adherence to doctrines of uniformity: for, in the spread of our paleozoic strata, there is evidence of much stronger submarine transportation than we now find; and even in Jurassic times there is a surprising area of cross-bedded sandstones in the region of the Colorado plateau."

Those who have followed the discussion in *Nature*, of the theory of ancient high tides proposed by Professor Ball as a lesson to geologists, will perhaps remember that I declined to receive the lesson, and denied the existence of the imagined high tides, because the geological record not only contains no traces of such tides, but, on the contrary, supplies abundant evidence that no such violent action accompanied the formation of the sedimentary rocks. In making this statement I was not constrained by any devotion to uniformitarianism, as the reviewer intimates, but based my conclusions upon an unbroken series of *facts*. These facts prove that the accumulation of the paleozoic rocks took place in conditions essentially like those which prevail at present, and show conclusively that the statement, "that in the spread of our paleozoic strata there is evidence of much stronger submarine transportation than we now find," is unwarranted. As that statement and those I have made are in direct conflict, and the question involved is an all-important one in the reading of geological history, I take the liberty of reviewing briefly the evidence on which my conclusions were based.

In the Cambrian age were laid down, along the eastern margins of our continent, the Acadian shales of New Brunswick, the Olenellus shales of Vermont, the shales and limestones of Troy, and the shales (now siliceous slates) of Braintree, Mass., — all the products of quiet deposition. In the Mississippi valley the Cambrian strata are buried, and inaccessible to us. In the Lake Superior region the copper series was probably deposited in the Cambrian age, although demonstration of this has not been obtained. There volcanic disturbances and eruptions produced great activity in the agents which form mechanical sediments, — conglomerates, sandstones, and shales; but this violence was all local, as we find no traces of it outside that area. In the far west the Cambrian rocks are well exposed in many places, and constitute twelve thousand feet of shales, with one stratum of limestone in the section of the Colorado Cañon, seven thousand feet in Nevada, and twelve thousand feet in the Wasatch, of sandstones, shales, and limestones, according as deposited under inshore, offshore, or open-sea conditions, but nowhere showing marks of more violent action than may be observed to-day.

In the lower Silurian rocks we have the record of a great continental subsidence, or elevation of the ocean-level; the advance of the sea upon the land; and the spread of a sheet of sea-beach material — the Potsdam sandstone — as far as the invasion extended. But the Potsdam beach was precisely like the beaches of to-day, — ripple-marked, sun-cracked, bored by annelids, strewed with seaweeds, and abounding in the entire or broken shells of beach-inhabiting brachiopods. Above this we have the organic deposits made by the Silurian sea when it stood over the submerged territory, — a thousand feet or more of limestones. Then the Hudson River and Utica shales were laid down in the shallower waters of the retreating sea. Here we have a complete history of the physical conditions which prevailed during the formation of the lower Silurian rocks, but nowhere find any traces of the high tides of Professor Ball's interesting but imaginative lecture.

A similar round of deposits composed the upper Silurian, the Devonian, and the carboniferous systems. Each group of rocks tells its own story so clearly that a child may comprehend it; and that story is not only without any high-tide episode, but is clearly and positively contradictory to the high-tide theory.

Your reviewer cites no facts to sustain his statement, and there are none. The cross-bedded mesozoic sandstones of the Colorado plateau have, of course, no bearing upon it, and they afford no support to the high-tide theory: they simply show that peculiar conditions prevailed in the triassic age over a limited area on the east side of the Wasatch, where a shallow sea was moved with strong currents, tidal or otherwise. On the west side of the land which separated this ancient Bay of Fundy from the Pacific, the triassic and Jurassic strata show no such violent action; and the same may be said of other parts of the world. The records of the cretaceous age, which are the most complete and completely exposed to view of any, are the most conclusive in their demonstration of the absence of violent and abnormal action in the processes of nature.

I may also call the attention of your reviewer to the fact that Prof. G. H. Darwin, whose study of the physical structure and history of the system of Mars was the inspiration of Professor Ball's lecture, declines to subscribe to his conclusions, and concedes that there is no evidence of abnormally high tides since the beginning of the paleozoic ages.

J. S. NEWBERRY.

The flora of Labrador.

A contributor to No. 59 tells us that "I have endeavored to show that we must look to the north for the place of origin of many of our plants," and that he "can see further reason for the assertion" in an analysis which he makes of a very incomplete list of the flora of Labrador. He further teaches us, —

> "That many of these plants were at one time distributed all around the Arctic circle, there can be no doubt; and that they have been driven from their first homes by the excessive cold, and found suitable abiding-places at the south, must also be considered as an established fact."

Now, Mr. Editor, is not all this so well established and so familiar as to render superfluous the *endeavor to show it* in the form of a contribution to *Science?* Whatever may be said upon the question 'where did life begin?' considered deductively, there is no longer any doubt as to where the vegetable life around us came from; nor does your contributor throw any new light upon the matter, in the column which he fills.

BOTANICUS.

How do the winds blow within the storm-disk?

The following method of showing graphically and concisely the result of many observations on storm-winds may, on account of its simplicity, prove of value to students of meteorology. Synchronous observations of winds charted on weather-maps for any single epoch are generally too few and often too discordant to give a precise picture of the spiral course followed by the whirling air; and it is difficult to combine by

eye-memory the observations plotted on several separate charts. But this combination can be made easily

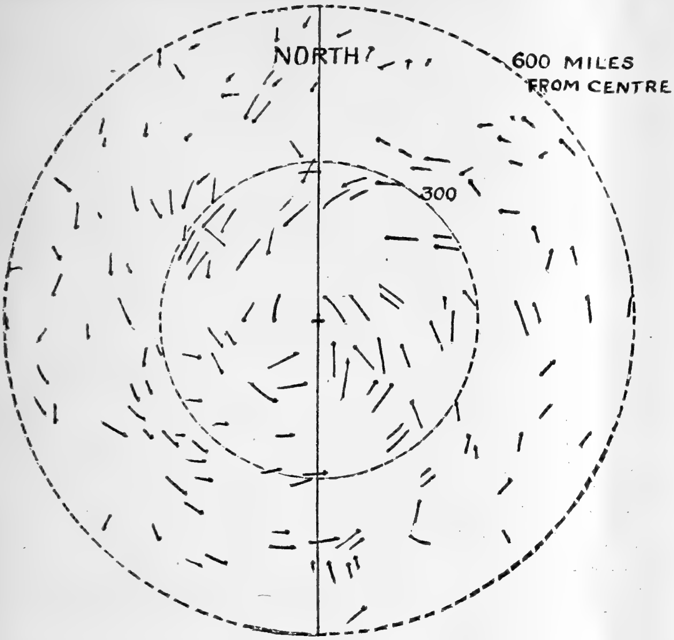


FIG. 1.

and accurately by taking off the records of successive dates on a single sheet of tracing-paper. A cross on the paper marks the storm-centre, always to be placed on the middle of the area of low pressure; and a north line, laid parallel to the meridians, serves as a means of orientation. A large number of observations may thus be transferred to a single figure, and every one of them falls in its proper position with respect to the centre of the storm.

The synchronous charts of the North Atlantic for August, 1873, prepared by Capt. Toynbee of the British meteorological office, yield a hundred and fifty-seven wind-records within six hundred miles of the centre of a cyclone that passed from the West Indies along our coast in the ten days from the 18th to the 27th of that month. These are all brought into the accompanying diagram (fig. 1), which shows very clearly, first, that the stronger winds are nearly all inside the circle of three hundred mile radius, where the longest arrows represent hurricane violence, or twelve of the Beaufort scale; and, second, that these winds have, with notably few exceptions, a distinct departure from a circular path to an incurving spiral. Very evidently, therefore, the centre of this storm would not bear 'about eight points' to the left of the wind's course, as the older mariner's guides put it, but generally about six, or in some cases even as little as four, points to the left, as has been shown in many other examples.

Fig. 2 shows the result of similar treatment of several days' records of storm-winds in our northern states, as mapped in the Signal-service daily bulletins for October, 1877. Observations north of the centre are unfortunately rare, as we have not as yet sufficient stations in the British possessions. Although the three hundred arrows show numerous discordant directions, the general motion indicated by them is again clearly an incurving spiral.

This method of concentrating observations on a single diagram may prove of service in several directions of storm-study, being applicable to the determination of the general form of isobars, and areas of cloud and rain, as well as to the investigation of the inclination and velocity of the wind in different quadrants of the storm, or at stations of different situation as to distance from the coast-line, or elevation above sea-level.

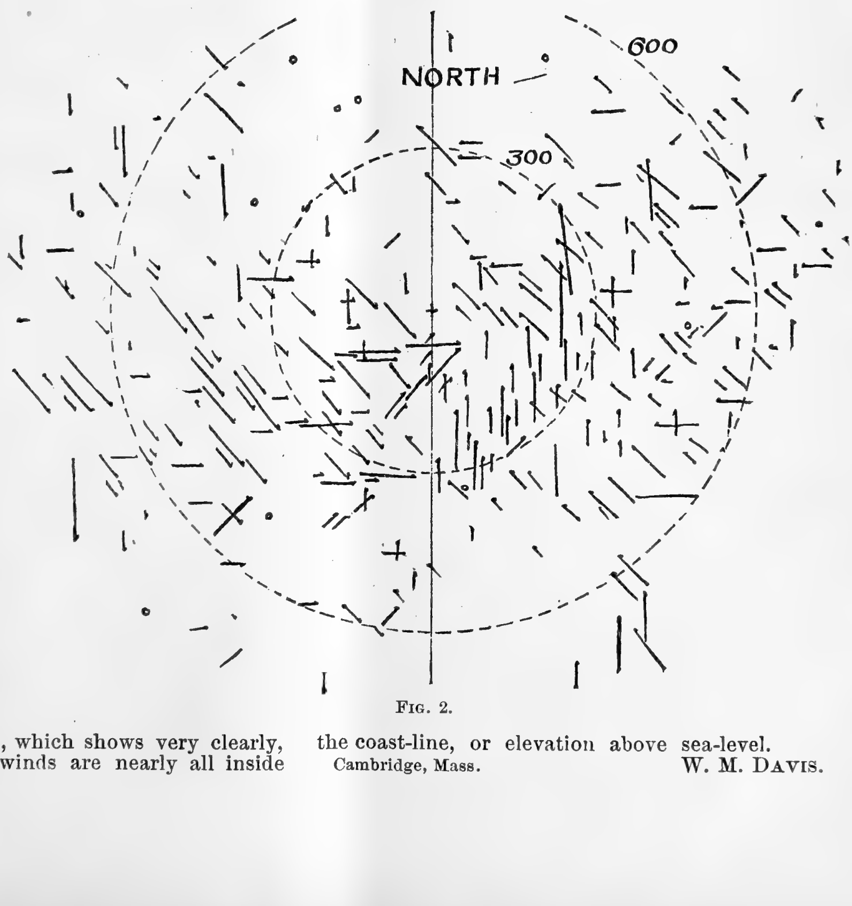


FIG. 2.

Cambridge, Mass. W. M. DAVIS.

Undulations in clay deposits.

A ditch about two feet deep, and running nearly east and west, on the grounds of this college, presents a profile as if the clay (which is of unknown depth) had been shaped into undulations, with crests from eight to fifteen feet apart, and then covered unconformably by the sandy soil, which over the crests is about two or three inches deep, and in the troughs about two feet at most. The 'strike' of the crests is nearly north and south. This peculiar formation has been observed over a large area of country in this vicinity. A surface peculiarity is the occurrence, at intervals of one or two hundred yards on the prairies, of low mounds a foot or two high, usually covered with dewberry briers. West of this place, in Milam and Williamson counties, the nearly level prairies are mammillary, with slight elevations eight or ten feet apart, presenting the appearance of old tobacco or potato hills on a gigantic scale. These appearances, visible from the cars, excite the curiosity of all who observe them; and a plausible theory of their cause might not only gratify this, but lead to some very important discoveries in dynamical geology. For these reasons I desire to present this problem to your geological readers; and, if it has already been solved, my apology for ignorance of the solution must be that I am not a geologist. H. H. D.

Agricultural and mechanical college of Texas,
College Station.

'A singular optical phenomenon.'

Having made the phenomena of binocular vision a special study for many years, I was greatly interested in the letter of 'F. J. S.' in *Science*, No. 57. But I confess I do not quite understand it. I can but think that the phenomenon he describes is only an example of '*phantom image*,' produced by binocular combination of similar figures of a regular patterned field — in this case, the squares of the coarse screen. But in that case the image ought not to be inverted nor enlarged. As to the inversion: if, as I suppose, your correspondent imagines it inverted only because it moves with the head, he is probably mistaken. There is no optical law by which an inverted image could be formed under the conditions described. The movement of the image is simple parallactic motion. The point of sight being the centre of parallactic rotation, if the image be nearer than the object, the motion will be in the same direction as that of the head of the observer; but, if the image be farther off than the object (a far more difficult case), the motion of the image will be opposite that of the head.

There still remains, however, the enlargement of the image. This is incomprehensible to me. It ought to be diminished in exact proportion to its nearer distance. Neither can I at all understand what is said about the phenomenon as seen by a near-sighted person. I should be glad if your correspondent would repeat and describe more accurately the phenomenon; for there are no phenomena more illusive, and requiring more practice to understand, than those of binocular vision. If I am right as to the nature of the image, it ought not to be seen with *one eye only*.

The subject of phantom images is fully explained in my little volume on 'Sight,' pp. 107–119.

JOSEPH LECONTE.

Berkeley, Cal., March 18, 1884.

The possible origin of some osar.

The writer does not profess to have an extensive acquaintance with these problematic structures; but, a few examples having been discovered in his researches in Dakota, the subject of their origin has been thrust upon him.

From several considerations, which need not be given here, it seems extremely improbable that the quaternary glaciers in that region bore, either on their surface or in their depths, any considerable amount of *débris*, at least nothing coarser than dust upon their surface, and perhaps gravel in their lower portions. How, then, can steep meandering ridges nearly continuous for miles, ten to thirty feet in height, running nearly at right angles with a great moraine, and much more stony than the surrounding surface and the general mass of the till, be explained?

The following hypothesis is offered for criticism. Given a sub-glacial stream, or a super-glacial one, which, near the edge of the ice-sheet, has cut an ice-cañon through to the ground moraine: the presence of the ice-cliffs on either side would tend to force a plastic body like the till toward the stream, and cause it to rise underneath the stream, like the 'creeps' frequently occurring in coal-mines or deep cañons. Now, if the streams have only a velocity sufficient to wash out and carry off the finer material, the bowlders and gravel will be left in excess, and in ridges along the line of the stream. Of course, stratified beds of sand and gravel would form a considerable portion of hills produced in this way, just as in the case of those formed according to the usually accepted theories. Similar breaks and lateral repetitions of the ridges might result according to either of the theories.

It seems, moreover, not improbable that some of the re-entrant spurs of terminal moraines may have begun in this way; the cañon developing into a notch, and giving rise to lateral flowage of the ice, as well as increeping of the till. J. E. TODD.

Tabor, Io.

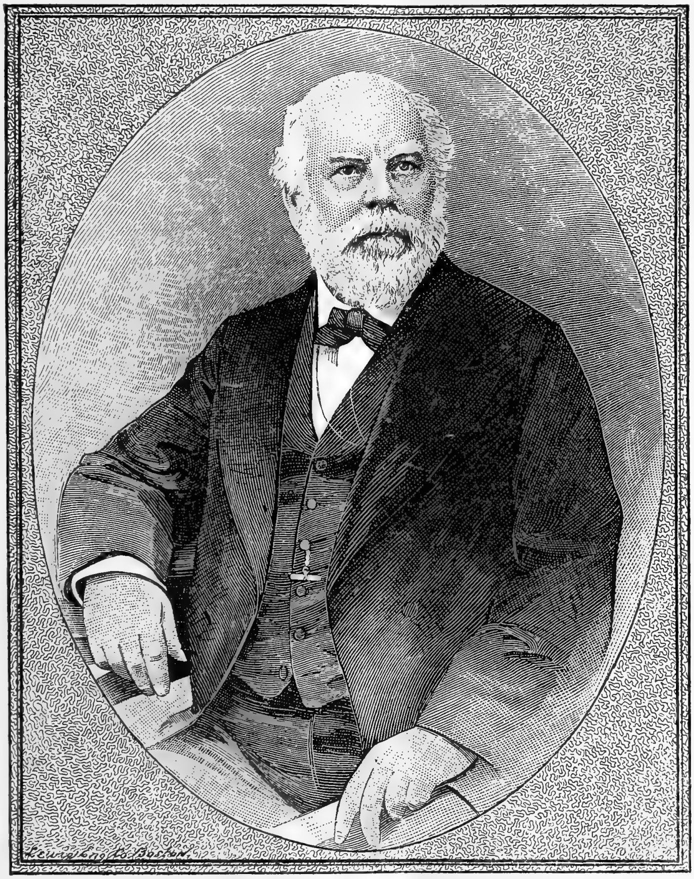
Osteology of the cormorant.

In late numbers of *Science*, several communications have appeared from Dr. Shufeldt (ii. 640, 822; iii. 143) and Mr. Jeffries (ii. 739; iii. 59) on the 'osteology of the cormorant,' and especially on so-called 'occipital style;' and complaint is made by Mr. Jeffries (iii. 59) that Dr. Shufeldt 'does not mention the nature of the bone' in question. Neither gentleman seems to have been thoroughly acquainted with the literature of the subject; and inasmuch as both are members of a committee of the American ornithologists' union, appointed to investigate the anatomy and physiology of the birds, they may be thankful for a reference to a special paper on the anatomy and functions of the bone in dispute. It is to a memoir by William Yarrell that I refer. Yarrell designated the 'occipital style' of Shufeldt as the 'xiphoid bone,' and in 1828 communicated to *The zoölogical journal* an article (iv. 234–237, art. xxviii.) 'on the use of the xiphoid bone and its muscles in the corvorant (Pelecanus carbo Linn.),' which is accompanied by two figures on plate vii. (figs. 5 and 6) illustrating the skull, with the xiphoid bone, and the muscles in relation with it and the lower jaw. The development of the peculiar bone is correlated with the weakness of the lower jaw; but for further information those interested must refer to *The zoölogical journal*, where they will likewise find references to the views of other authors.

Lest *Science* or myself should be charged with making or overlooking a typographical error, I beg to add that 'corvorant' is the substitute for cormorant, adopted by Yarrell, probably from a false or confused idea as to the etymology and history of the word. THEO. GILL.

GEORGE ENGELMANN.

George Engelmann was born in Frankfort-on-the-Main on the 2d of February, 1809. He died in St. Louis just after the completion of his seventy-fifth year, on the 4th of February, 1884, very unexpectedly, and after an illness which had kept him from his scientific work but a few days.[1]



Dr. Engelmann received his medical education and early scientific training at Berlin, Heidelberg, and Frankfort. Agassiz, Alexander Braun, and Charles Schimper were among his college-associates and lifelong friends. His determination to establish himself in the United States must have been made early; for he left Germany almost at once after graduation, reaching New York in 1832. His first visit was to Philadelphia, attracted there by the scientific reputation of that city, where he was fortunate enough to make the acquaintance of Nuttall and other scientific men. His inclinations, however, still turned westward; and young Engelmann soon left the seaboard, to seek a home in the almost unexplored regions beyond the Mississippi. He went first to St. Louis, then scarcely more than a frontier trading-post, influenced, no doubt, in this step by the fact that there was already a little colony of Germans located there. But Dr. Engelmann did not at once establish himself in St. Louis. With the deliberation and care which characterized all the actions and studies of his life, he determined to see something of the western country before finally selecting a home. For this purpose he undertook a long and solitary journey on horse-back through south-western Missouri, Arkansas, and western Louisiana. This journey was probably made in 1833, and occupied six months. It nearly cost Dr. Engelmann his life; for the young traveller took a dangerous fever among the Arkansas swamps, into which his botanical zeal, no doubt, often led him. Fortunately he fell into the hands of a negro family, who nursed him faithfully through his long illness, which cut short further exploration, and hurried him back to St. Louis.

Here Dr. Engelmann finally established himself as a physician in 1835. He had previously, however, gone to Germany, and on his return had brought back with him, to his new home, the faithful and devoted companion who shared his labors, his trials and triumphs, for more than forty years. From 1835 until his death Dr. Engelmann continued to live in St. Louis, and to devote to scientific investigations every moment which could be spared from a large

[1] The announcement which appeared in a previous number of this journal, that Dr. Engelmann died on the 11th of February, was erroneous: he died on the 4th of February.

and absorbing professional practice. He was able, however, to make, at long intervals, several visits to Europe (the last as recently as last year) largely for the purpose of botanical study; although his opportunities for extended botanical explorations in his adopted land only came to him late. Twice in the last ten years of his life Dr. Engelmann was able to see Colorado; in 1876, he visited the southern Alleghany Mountains; and in 1880 made a long journey through the forests of the Pacific states, where he saw for the first time, in a state of nature, plants he had studied and described more than thirty years before. Dr. Engelmann's associates in this long and arduous journey will never forget his courage and industry, his enthusiasm and zeal, his abounding good nature, and his kindness and consideration of them and every one with whom he came in contact.

Engelmann's first botanical publication appeared as long ago as 1832, when, on the eve of his departure for the United States, he printed in Latin a *dissertatio inauguralis*, 'De Antholysi prodromus,' illustrated by drawings made by the author. This paper is still sometimes referred to, and was certainly a remarkable production, in view of the youth of the writer, and the existing knowledge of vegetable morphology. No other botanical paper appeared from Dr. Engelmann's pen until 1842, when he published in the *American journal of science* his monograph of North-American Cuscutineae. He had, however, some time before, in association with Capt. C. Neyfeld, undertaken the editorship of *Das westland*, a journal printed in Heidelberg, and intended to make known to German emigrants the advantages of the Mississippi valley. This publication did not outlive the first volume, which bears upon the titlepage the date of 1837, and which contains three articles by Engelmann, generally descriptive of the natural features of the western country, with some account of his southern journey of 1833. If these early years in St. Louis were not prolific in botanical publication, their botanical occupations were not the less important and valuable. He made, at the time, large collections of western plants, then hardly, if at all, represented in European herbaria, distributing them freely among his German correspondents. At this time, too, he made the acquaintance of the authors of the 'Flora of North America,' to whom Engelmann first became known through the discoveries, by the younger of the two botanical partners in this undertaking, of some of his specimens in the Berlin herbarium. This rather roundabout introduction led to a warm friendship and close and sympathetic scientific association, which has largely shaped the botanical studies over a great continent, and which death only has interrupted.

The appearance of the monograph on Cuscutineae, which was soon republished in the *Botanische zeitung* and the *London journal of botany*, established Engelmann's reputation as a systematic botanist, and procured for him the correspondence of Hooker and other foreign botanists. Several new species are described in this paper, and the genus Lepidanche proposed for a Cuscuta-like plant of the western prairies. Cuscuta always interested Dr. Engelmann; and in 1859 he published in the Transactions of the St. Louis academy an elaborate revision of the whole genus, for which he had long been collecting material.

In 1842 he published in the *American journal of science* a list of plants collected by Charles A. Geyer in Illinois and Missouri, in which several species are first described; and in 1845, in the *Journal of the Boston society of natural history*, in collaboration with Asa Gray, an enumeration of plants collected in western Texas by his countryman, Ferdinand Lindheimer, a naturalist attached to the German colony of New Braunfels.

In 1848 was published his sketch of the botany of Dr. A. Wislizenus' expedition. Dr. Wislizenus, a German physician and a resident of St. Louis, had been attached to Col. Doniphan's expedition, but was taken prisoner by the Mexicans, and carried to Chihuahua, where, as well as in the valley of the Rio Grande, he had made important botanical collections. These were afterwards placed in Dr. Engelmann's hands for elaboration. The study of these collections exerted a powerful influence upon his subsequent botanical studies. They first drew his attention to Cactaceae and Pinus, which continued to occupy his thoughts for the remainder of his life, and of which his knowledge was unequalled. As early as 1856, Dr. Engelmann published in the Proceedings of the American academy a synopsis of the Cactaceae of the territory of the United States. Two years later appeared his 'Cactaceae of the boundary,' in the second volume of the United States and Mexican boundary survey report. This paper, superbly illustrated by drawings made (under Dr. Engelmann's direction) by Roethe, is, perhaps, his best-known botanical work. Dr. Engelmann has studied and described all the collections of Cactaceae which have from time to time been made in the Mexican boundary region, and, had he lived,

would have elaborated the whole order in accordance with his latest views of the subject. He even proposed so late as last year to pass a considerable time in northern Mexico for the purpose of studying these plants in their native country before finally giving to the world the final results of his long investigations. That he did not live long enough to elaborate the mass of material he had so industriously collected for this work is an irreparable loss to botanical science; for no other hand, in this generation at least, will be able to take up this family where he has left it.

Other difficult genera have long been studied by Dr. Engelmann. His predilections, indeed, have always been for the most difficult and perplexing plants; and he willingly devoted himself to such genera only as less patient investigators hesitated to take up. Thus he mastered the North-American Euphorbiaceae, elaborating all recent collections of the family, without, however, undertaking a complete revision of the order as represented in this country. He published an elaborate and exhaustive paper upon the North-American species of Juncus, and, later, one on the North-American Isoetes. His published notes upon the North-American species of Quercus, for years one of his most engrossing subjects, and upon North-American Abies, Juniperus, of the section Sabina, and upon the genus Pinus, contain the most valuable and trustworthy information which has appeared upon these plants. In 1873 Dr. Engelmann published, under the title of 'Notes on the genus Yucca,' his elaborate revision of the genus here first comprehensively treated. Two years later his notes on Agave appeared, in which are enumerated and described the species detected within the limits of the United States, as well as a few foreign species previously imperfectly known. Dr. Engelmann studied for many years the genus Vitis; and our knowledge of the North-American species is due in a large measure to his investigations. His last botanical publication, a sketch of the true grapevines of the United States, although written some months earlier, and previous to his last European journey, was issued late in 1883.

Dr. Engelmann's botanical writings were not voluminous. All his work, however, is characterized by the most careful and conscientious preparation, great good judgment, classical methods of treatment, and remarkable thoroughness. His investigations were slow and laborious, often lasting for years in the case of a single plant. No botanist was ever less anxious to publish prematurely the results of his observations, or was less satisfied with the extent of his own knowledge. Such admirable, and in these days unusual, caution has made Dr. Engelmann's botanical writings masterpieces in their way, worthy to stand with the best productions of their nature which have yet appeared. This very caution and desire to wait for completeness, however, which have made Dr. Engelmann's published papers what they are, have cost the world a vast store of valuable information collected by him during long years of careful investigation, but never quite ready, in his critical judgment, for publication.

Dr. Engelmann, in addition to his professional and botanical labors, was a most zealous meteorological observer, and at the time of his death was probably one of the oldest meteorologists in the United States. He published many important papers upon this and various physical and topographical subjects, but the length to which this notice is already extended precludes more than the mere mention of this fact. His meteorological and other miscellaneous papers, as well as his important botanical papers since 1859, have been published in the Transactions of the St. Louis academy of science, which he was largely instrumental in establishing, and which he long served as president.

Dr. Engelmann was a member of the American academy of arts and sciences, a corporate member of the National academy of sciences, a foreign member of the Linnaean society of London, and an active or corresponding member of many other learned bodies. His career was eminently successful. He lived to see the correctness of his judgment in selecting St. Louis as his adopted home confirmed, the frontier trading-post grown into a great city, and himself at the head of his profession there, and then his place occupied and worthily filled by his only son. He long enjoyed the friendship, the respect, and the correspondence of many of the most distinguished botanists of the age, everywhere the recognized authority in those departments of his favorite science which had most interested him.

George Engelmann, it is fair to assume, will long live in his botanical writings. The thoroughness of his work leaves little to subsequent workers in his chosen fields to gather, and secures its permanent usefulness and value. When, however, his written words are forgotten, the western plains of his adopted land will still be bright with the yellow rays of *Engelmannia;* and the splendid spruce, the fairest of them all, which bears the name of Engelmann,

will still, it is to be hoped, cover with noble forests the highest and most inaccessible slopes of the Rocky Mountains, recalling to men, as long as the study of trees occupies their thoughts, the memory of a pure, upright, and laborious life.

THE MAXIMA AND MINIMA TIDE-PREDICTING MACHINE.[1]

THIS machine has been invented by Mr. Ferrel, and constructed by Fauth & Co. of Washington, for the use of the Coast and geodetic survey. Its object is to determine mechanically the times and heights of high and low waters for the numerous tide-stations around our coast, for which tide-tables are annually published. The numerical data for these have been heretofore obtained by computation; but, on account of the great complexity of the tidal theory and formulae, this involves a great amount of labor to obtain even approximate results, and more accurate ones have to be dispensed with, unless they can be obtained in some way mechanically, with much greater facility than by computation.

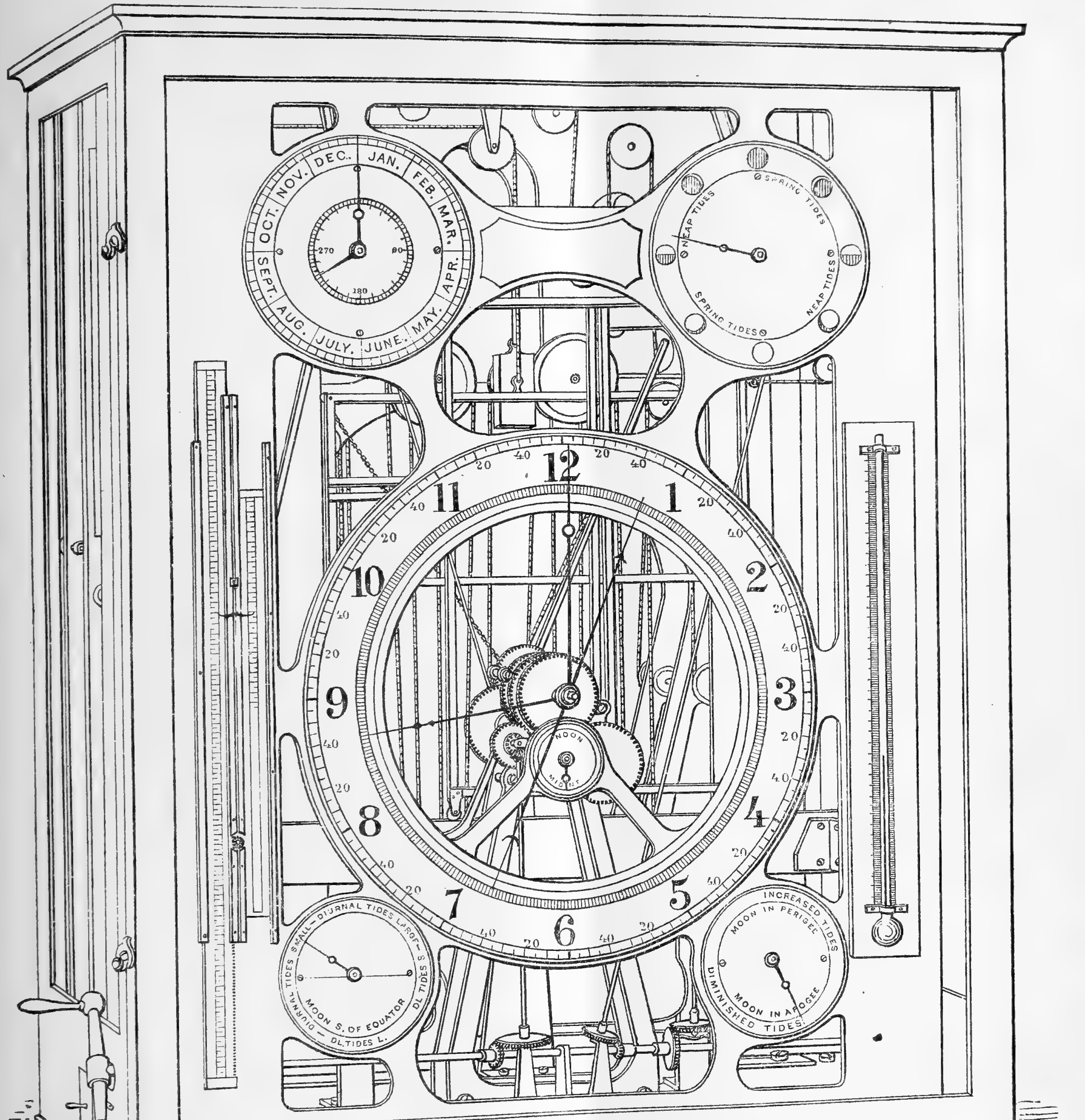
The first tide-predictor was invented by Sir William Thomson, about eight years ago. This was constructed so as to take into account about ten only of the principal tide-components; all, however, which are of much practical importance. This machine has not been used in the regular prediction of tides, and is said to be now on exhibition at the South Kensington museum.

Subsequently Mr. Roberts, of the *Nautical almanac*, London, had another constructed upon somewhat the same plan, but larger, taking into account twice as many of the components, and having some improvements on the plan introduced. A description of this machine was given in *The engineer* of Oct. 19, 1879. It is now being successfully used in the prediction of the tides of India.

Both of these machines have been constructed so as to be run by clock-work, and to give the results in the form of a tide-curve for one year on a roll of paper, from which the times and heights of high and low waters are afterwards read off and recorded.

In the maxima and minima predictor, only the maxima and minima of the heights of the tide above mean low water or any other assumed plane of reference, and the times of their occurrence, are indicated; as these alone are required for the tide-tables annually published. For this purpose a transformation of the tidal harmonic function was necessary, so that it would give heights and times of the maxima and minima; and, as any such transformation usually renders the resulting expression much more complex than the original one, the whole theory and construction of this machine is much more complex than in the case in which the machine is required to give the height of the tide at regular stated intervals of time, or a graphic representation of the whole function. In this machine both the clock-work and roll of paper are dispensed with, and the machine is run by means of a small crank at the side, with the left hand; and the times and heights of high and low waters are read off from the face of the instrument, and recorded as you go, with the right hand, upon blank forms ready for the printer. The great advantage which is claimed for this form of the machine is that it gives only what is required, and this in such a way that the results can be recorded at once, and the trouble of handling long rolls of paper, and estimating the times of maxima and minima, and reading off the corresponding height of the tide, is saved. Although the machine is more complex, this makes no difference in the facility with which the results are obtained. The crank is turned until an index on the central dial of the face, called the lunar index, pointing between eight and nine on the accompanying perspective representation of the face of the instrument, comes in conjunction with the upper end of an oscillating needle, the upper end pointing between twelve and one, as represented, when the time of high water is pointed out by another index on the same dial, called the solar index, pointing, as represented, to the figure twelve, at noon and midnight, and the height is indicated by an index on a vertical scale on the left side of the face of the instrument. You then turn until the lunar index comes in conjunction with the lower end of the needle, when the solar index points out the time of low water, and the index at the side, its height. Turning until the lunar index comes in conjunction again with the upper end of the needle, you read off, as before, the times and heights of the next high water; and so on from high to low and from low to high water through the year, recording the results as you go. Where, however, there are large diurnal components, it is necessary to run through twice, — first for the times, and then, after a little change in the setting, for the heights. The machine, therefore, is especially convenient for most of the tides having a large range upon our At-

[1] This article, written by Mr. WILLIAM FERREL, is published by permission of the superintendent of the Coast and geodetic survey.



lantic coast, since the diurnal components in these are very small.

It would be impossible, in this short sketch, to give any idea of the theory and construction of the machine. These, however, will be contained in an appendix to the report of the superintendent of the U. S. coast and geodetic survey for 1883.

The efficiency of the machine is in general very satisfactory. The results given by it have been compared both with computation and observation. In a comparison with one

month's computation of the tides of Boston harbor, the differences in the heights rarely exceeded more than 0.1 of a foot, and in the times more than three or four minutes. These differences arose from a slight yielding of some parts of the machine from a lack of sufficient rigidity. This, however, could be mostly remedied at small expense, if thought necessary, by making some parts of it a little more rigid.

In a comparison of the results given by the machine for three months, of the tides of San Diego, Cal., having very large diurnal components, with the times and heights from observation, the average of the differences, taken without regard to signs, was 0.29 of a foot, and in the times about ten minutes. But these differences are due mostly to meteorological causes, changes in the winds and in the barometric pressure, which cause fluctuations in the mean level of the sea, and are due only in a small measure to imperfections of the machine. These are most conspicuous in cases where the tide-wave becomes very flat from the high or low water of any day being brought very nearly to mean sea-level from the effect of large diurnal components, or where the whole range of the tide is very small; but in such cases the times of maxima and minima are very indefinite, and the error is more in appearance than in reality.

The machine is now being used in the prediction of the tides for the tide-tables of the year 1885, and is in all cases first applied for each station to some year for which there are observations for comparison, and, with the exception of the slight defect referred to, is giving entire satisfaction. The capacity of the machine for doing work is at least that of thirty to forty computers, if these were to take into account every thing which the machine does. In fact, little more time is required than that which is taken up in recording the results.

NOTES ON THE LAVA-FLOW OF 1880-81 FROM MAUNA LOA.

THE Hawaiian Islands are entirely of volcanic origin. The various islands appear very distinctly to be of different ages, the volcanic agencies still being continually active in the most south-easterly one, while in those to the north-west they have been extinct for a long period of time.

Hawaii, the largest island, situated at the extreme south-west of the group, has an area of about 4,200 square miles, being about twice the size of the state of Delaware, and not quite so large as Connecticut. It has four prominent elevations, each of which marks what is or has been a centre of activity. The Kohala Mountains, with an elevation of about five thousand feet, form the northern end of the island: though thickly covered with well preserved crater-cones, their activity ceased before the earliest traditions of the natives. Mauna Kea, the highest peak of the group, with an altitude of 13,825 feet, has also long been extinct. This lies to the south-east of the Kohala Mountains, on the eastern coast. Nearly opposite, on the western coast, is Mauna Hualalai, a little more than 8,000 feet in height. The last recorded eruption from this took place in the year 1801. When visited in the spring of 1882 by J. T. Perryman and J. S. Emerson of the Hawaiian government survey, steam was found to be issuing from several of the fissures on the summit.

South of the preceding three elevations is Mauna Loa, on whose summit, 13,610 feet above the sea, is the active crater of Mokuweoweo. The slopes of Mauna Loa are very gentle, and, when seen from a distance, the whole mountain appears like a gentle swell of land. On its eastern slope, at an elevation of about 4,000 feet, is the famous active crater of Kilauea. This is commonly regarded as a portion of the mountain of Mauna Loa; but it is in reality a separate mountain, though situated so near the other that the lavas from each have flowed together till the outline of this mountain has nearly been merged in that of the other. As seen from the upper portions of Mauna Loa, the individuality of Kilauea is clearly apparent.

During the last hundred years many flows of lava have taken place from both these mountains; all bursting forth from the sides approximately near the summit, but none coming from the crater itself. These have been well described by Rev. Mr. Coan of Hilo, Hawaii, by W. T. Brigham of Boston, and others.

On the 6th of November, 1880, the latest of these flows burst from the north-eastern side of Mauna Loa, at an altitude of about 10,000 feet. From this point it gradually passed down the slope of the mountain, at first toward the north-east; then, making a sharp bend, it flowed for some distance toward the south-east, and then, once more making a sharp bend, took a course directly toward Hilo, a small but pretty village on the eastern coast. The first portion of its course was over a country composed entirely of naked lava above the limits of vegetation. It then entered the belt of forest which skirts the mountain with a

width of seven to ten miles. Through this it slowly ate its way, making a clear, clean path, and finally appeared on the lower side within five miles of Hilo. When within less than two miles of the village, it divided into two branches, one still continuing directly toward the village, and the other taking a course toward the Waiakea sugar-mill, which is about one mile south of Hilo. Finally, in the middle of August, 1881, the flow suddenly ceased, when the Hilo branch was just one mile from the town-house, and the Waiakea branch thirty-six hundred feet from the mill. It had then been flowing a little more than nine months, and had passed over a distance of about forty-five miles.

I arrived in Hilo on the 8th of September, 1881, and immediately visited the flow. This was about three weeks after its cessation, but I found it still very warm. Standing on Halai, a small crater-cone near its lower extremity, nearly its whole length could be traced by the steam arising from it after a shower. I found its surface to be seamed with cracks and fissures in all directions. Some of these were mere cracks, while others were six and eight inches, perhaps more, in width. This made walking over it rather difficult. There are two common forms of lava known there, — the *pahoehoe* (satin) and the *a-a*. The former, which is far the more abundant, has much the appearance of folded satin, and usually spreads out in broad, level fields. Sometimes it swells up through some hole in the surface, and forms

large dome-like masses. The above view gives a very fair idea of this variety of lava. The *a-a*, which forms only a very small portion of this flow, is very rough and jagged, and is almost impassable, being totally so to horses. An adequate description of this peculiar formation is impossible. It must be seen to be appreciated. I have as yet seen no adequate explanation why lava sometimes takes this form. Analyses show the chemical constitution of the two varieties to be about the same. It seems to occur, without any particular reason, at various points on the flow, in areas varying from a few rods to an acre or so. In its pas-

A CATARACT OF RED-HOT LAVA FALLING INTO A POOL OF WATER.

sage through the forest, the flow encountered trees of all sizes, to a yard or more in diameter. Flowing around these, it solidified sufficiently to retain a complete mould of the trunks before they burned off. By means of these upright moulds or wells it is comparatively easy to measure the depth of the lava at any point throughout this portion of its length. This I found to average about twenty feet, though varying very much in particular instances, according to the nature of the surface over which it flowed.

As their trunks burned off, the trees fell upon the surface of the still plastic lava with sufficient force to impress upon it a mould of a portion of their outline.

In both the vertical and horizontal moulds a peculiar impression was made upon the surface of the lava in contact with the tree. It took on a honeycomb structure, presenting a series of indented squares. The cause of this peculiar form I have been unable to determine. The indentations are certainly not the impression of the bark of the trees, and they are altogether too regular to be the result of the expansion of gases.

The general structure of the flow, throughout its entire length, is that of a long, central tunnel with numerous lateral branches. Flowing lava cools very rapidly, — indeed, so quickly, that I have often passed over the surface of that which I had seen flowing fifteen minutes before. Being a good non-conductor, the heat of the inner portions is long retained after the surface is once solidified. In this way a long central tube is formed, from the lower end of which the lava continually flows, while it continually extends the length of the tube. The pressure along the tube is constantly becoming too great for its sides to bear, and lateral off-shoots are formed, increasing the width of the flow. These lateral tunnels usually fill up, and finally become solid. The central tunnel, however, remains hollow throughout a large portion of its length, and may often be traversed for long distances after the flow has become cool. On my first visit to the flow, the top of this central tunnel had fallen through in many places, and I was able to look into it for some distance; but in every case I found the heat still too intense to allow me to descend into it. At later visits this became possible. The roof is commonly rough, a broken surface of lava, but in many cases is smooth and shiny, and covered with numerous stalactitic forms, seldom more than an eighth of an inch in diameter, but often having a length of five and six inches.

The stalagmite form was very rare, and only in one case did I find any of large size. In this instance the lava had flowed over a small precipice in a sheet in such a manner as to leave an opening between the sheet and the face of the precipice. Directly at the foot of the precipice were two peculiar stalagmitic forms made of drippings of lava about a quarter of an inch thick and three and four inches long. The larger of these was about a foot in height; the smaller, not more than half that size. These had evidently been formed by the lava covering a small spring, the steam generated from which had kept the lava above in a semi-plastic condition for some time. These specimens attracted much attention, as nothing of the kind had before been found. They may now be seen in the museum of the Boston society of natural history.

Owing to this peculiar property of lava to form tubes for itself in which to flow, it has the power to flow over small elevations, thus presenting the phenomenon of a liquid flowing up hill. It has the power to continue this till the pressure becomes too great for the strength of the sides of the tube.

The opposite view is from a photograph taken on the spot during the flowing of the lava. It shows the lava in the act of flowing over a precipice about fifteen feet in height. Each of the small streams seen trickling down the face of the rock is red-hot lava. This illustrates the fact that lava flows at the steepest angles, which is sometimes questioned. In this view the lava is flowing into a small pool of water, the resultant steam from which is seen arising like the mist of a cataract. This depression was afterward so entirely covered by the lava, that at my visit the spot could not be distinguished.

It would be interesting, if possible, to give an approximate estimate of the amount of lava which was forced above the surface during this eruption; but with the present data it is impossible. No survey of the flow has been made, and it is exceedingly difficult to estimate its dimensions by the eye. As a very rough estimate, I should place it at something more than five hundred million cubic yards.

Geo. H. Barton.

THE STATE OF EXPLORATION IN AFRICA.

The exploration of the dark continent continues with unabated vigor, in spite of the occurrences in the Sudan which nevertheless, in the form of disturbing rumors, must, even at a considerable distance, exercise an evil influence upon the native population.

Humblot, the French naturalist, has been commissioned by his government to investigate the botany and zoölogy of the river-basins of the Kongo, Ogowé, and Gaboon. The Portuguese officers, Capello and Ivens, have been authorized to take up their studies in the same region, and to prepare a chart of the northern part of the province of Angola, belonging to the basin of the Kongo. Lieut. Wissmann is about to return to Central Africa, where Dr. Pogge still remains, and to continue for several years systematic explorations in the Kongo region. A large subscription for the support of the work has been raised in Berlin from scientific and especially from commercial sources, and the results for science and trade will doubtless prove important. His compatriot, Flegel, after exploring the sources of the Benowé, has been directed to proceed in a south-easterly direction, toward the Kongo. For this purpose the German government has reserved a considerable sum of money. He was at last reports about three hundred kilometres from the mouth of the Niger, at Abutchi, near Oniga. The Kongo question continues to form the subject in Europe of a host of pamphlets representing the views of the different parties contending for the control of trade on that great water-way. Most of them seem to carefully avoid touching the real and practical questions now at issue, and devote much space to considerations of a sentimental nature, growing out of matters a century or two old. The day for such reminiscences to have weight in practical politics would seem to have passed.

The French continue the work of establishing better means of communication in upper Senegal, for which the Chambers have recently voted five million francs. Kayes, at the head of navigation on the Senegal River, is now quite a well-constructed, active little town, where two years ago there was little more than a desert. Above this point, only flat boats are available as far as Bafulabé. From this point between one and two hundred kilometres of road, suitable for light two-wheeled vehicles, have been constructed, and fortified posts established at intervals, which are supplied by parties of armed natives, employing in the work more than three thousand pack or draught animals. The part of the railway already constructed is of great use in forwarding material for its extension. Small tramways or horse-railroads have been found of great use in the work of constructing the main line, and ten thousand kilometres of a patented form of tramway have been ordered for this purpose. The object of this at first sight extraordinary project of running a railway into a savage country, beside the protection of the rich colony of Senegal from the devastating incursions of the interior tribes, also includes tapping the Niger at its head waters, and securing the immense traffic of that great river without forcing a way through the pestilential swamps of its miasmatic delta. This is a commercial prize worth a round sum to secure, and in which French courage and enterprise will find an abundant recompense.

From South Africa, Coillard writes that he has reached his old station at Leribé in Basuto-land. Since his previous visit, war has desolated that fine country, and degenerated into guerilla warfare, by which the traveller suffered greatly on his journey. Later he proposes to strike out into the interior.

From equatorial Africa it is reported that Revoil, leaving important collections to be forwarded to Paris from Mogadoxo, had pushed on to Guélidi. Nothing has been heard from Giraud, who is following a route not in use by caravans; but news is shortly hoped for by way of Kakoma. Capt. Bloyet and his brave wife have arrived at Zanzibar, where he will prepare a report of his last expedition for the French committee of the International African association, and then continue his triangulation in the Usagara region, south-west from Zanzibar. Madam Bloyet has accompanied her husband everywhere, and rendered valuable service, both in his collecting and exploring work. The labors of the missionaries in this region appear to be producing some effect in doing away with the barbarous human sacrifices due to the belief in sorcery, formerly universal. These sorcerers are truly the plague of Africa.

The return of Dr. Fischer terminates one of the most important of recent journeys in Central Africa; and the publication of the results will be awaited with the highest interest. Joseph Thompson, who followed nearly the same route, was last heard from at Wandarobo, having suffered great hardships and many losses from wars waged by the cannibal and ferocious Massai tribe.

Fischer attempted to pass through the Massai country, yet untrodden by the whites, and to reach the reported Lake Baringo. When only six days' march from the object of his journey, he was forced by overwhelming numbers to retrace his footsteps, and pass around Lake Naivasha, where a large hot-spring was found by the Natron Lake near the Doego-ngai volcano, and thence, *viâ* Angaruka, to Mont Macru. Among other things, two hundred and sixty species of birds were collected.

Dr. Stecker has returned in good health from his explorations in the Galla country, south of Abyssinia, having mapped a large extent of country very carefully and thoroughly.

The usual tribute of noble lives has been demanded by the pestilential climate of Africa. Ernest Marno recently succumbed to fever in the upper Sudan, after having rendered, during fourteen years, distinguished services in the exploration of Central Africa. The unfortunate Dr. Matteucci arrived in London with Massari, from their recent journey across Central Africa, undermined by fever, wrote to his mother that he was about to join her, and in a few hours was no more. Schweinfurth sends an account of the assassination of Sacconi in the Somali country, during his attempt to reach the Wabbi River. He was cut to pieces by five Somalis, under circumstances almost identical with those attending the murder of Mademoiselle Adeline Tinne by the Tuaregs of Fezzan. His servant, who had been charged in such an event to secure the record of the journey, attempted to do so under cover of night, but was surprised, and barely escaped with his life. The record was torn and deliberately burned by a fakir of the tribe.

The unfortunate end of the Marquis Antinori is known. His successor, Count P. Antonelli, more happy, has returned to Rome, and has recently given an account of his investigation of Shoa, in south-eastern Abyssinia, to the Italian geographical society. This society is publishing the results of the Italian expedition. An interesting account of the fresh-water fishes of Shoa has already appeared. Soleillet, the French explorer of Shoa, appears from his reports to be living *en grand seigneur*, under the protection of his Shoan Majesty, King Menelik II., having been appointed to a feudal office somewhat between a baron and a justice of the peace. Bremond's report of his scientific and commercial expedition from the French colony of Obock to Shoa has recently been printed in *L'Exploration*. This region, though but a few years since untrodden by civilized men, offers rich rewards to traders; and the privileges of trade have lately been the object of lively competition between the commercial explorers of several nations. W. H. DALL.

GREEN MOUNTAIN RAILWAY, MOUNT DESERT ISLAND.

THE Green Mountain railway on Mount Desert Island, Me., is intended for pleasure-travel. It was operated for the first time during the last summer season. It is in a great measure a copy of the railway up Mount Washington, New Hampshire, built some thirteen years ago. These two lines, and the Mount Righi railway in Switzerland, are the only ones employing the central cog-rail as a means of surmounting steep gradients. The trip for tourists from Bar Harbor to the summit of Green Mountain is made, first, by wagons or stages, two miles and a half to Eagle Lake; thence by steamer on the lake two miles; and finally by rail sixty-three hundred feet, in which latter distance the ascent is twelve hundred and seventy feet to the summit, fifteen hundred and thirty-five feet above the sea. While the grade averages about a foot rise in four feet and a half distance, in some places it is as steep as one in three.

Surveys were made, and the work of clearing and grading was begun, in the winter of 1882–83. In April a large force of men was employed, and the road was completed by July 1. The track is not raised on trestle-work, as is the case at Mount Washington: much of it, especially on the heaviest grades, is constructed on the solid ledge. Where the longitudinal timbers, or stringers, rest directly upon the rock, iron bolts one and a quarter inches in diameter, six feet apart, are driven through them into holes drilled in the ledge. Where it is necessary to raise the stringers above the surface in order to make a regular inclination, bed-ties are used every six feet, secured against slipping by two or three one and a quarter inch iron bolts firmly fixed in the rear of each tie. All longitudinal timbers required to bring the line to grade are fastened to the bed-ties with iron bolts of the same size. The timbers and ties in contact with the rock were carefully hewed, and fitted to place. The spruce timber needed for this portion of the work was obtained from a forest-growth on the mountain itself.

The sleepers or ties, six inches square and six feet long, are laid upon the stringers at a distance of two feet from centre to centre, and two seven-eighth inch iron bolts are driven into the stringers, immediately in the rear of each tie, in grooves in the tie, which serve to prevent lateral motion. Upon the ties lie 'T'-rails, joined by fish-plates and bolts, and spiked in the usual way. The rack or cog-rail in the middle of the track is made of two angle-irons which have between them cogs of one and a quarter inch iron accurately rolled to uniform size. This cog-rail is secured to the ties by two lag-screws, five inches and a half long, in every tie, and additional ones at each joint. The rack was manufactured by the Atlantic iron-works, East Boston.

The engine weighs ten tons, and embodies all the improvements suggested by the operation of the White Mountain road. Its entire mechanism is double, — four cylinders, two cog-wheels, and two driving-shafts. Intermediate gearing between the crank-axles and cog-wheels reduces the speed, and increases the tractive force. The cog-wheel axles carry ratchet-wheels with pawls; and either one of these ratchet-wheels, in case of accident to the engine, will hold the train on any grade. In addition, two band-brakes on the smaller shafts may be instantly applied by the engineer. The ascent is made by steam-power; and the engine, when backing down the mountain, is still kept in forward gear, that is, with valves set to go ahead, so that it is constantly pumping air into its boiler; and this air, allowed gradually to escape, exerts an upward tractive force, thus easing the descent.

The floor of the passenger or observation car is adjusted so as to be level on the average grade, and the sides are open to admit of an unobstructed view. The car is always pushed ahead of the engine, and is provided with double hand-brakes, two cog-wheels, ratchet, and pawl, which will easily control the car in descending. CHARLES E. GREENE.

ANTHROPOLOGICAL PAPERS IN PETERMANN'S MITTHEILUNGEN FOR 1883.

IN order to keep pace with the growth of knowledge respecting the natural history of man, one must not neglect the geographical journals. The files of *Petermann's mittheilungen* for the past year will be found quite rich, especially in ethnographic information. The following summary will guide to the most important contributions.

Upon the subject of the variation of climate in the region of the southern Mediterranean and northern Sahara, Professor Fischer of Kiel holds, that, in this locality, a diminution of precipitation has taken place, the influence of which on health, population, and the means of living, is easily conjectured (pp. 1–4).

The subject of marshes, *instabilis terra nec navigabilis aqua*, begetter of pestilence, precursor of fertile

fields, and preserver of antiquities, is discussed briefly, in its relation to history and human weal, by inspector T. Schacht of Oldenburg (pp. 5–12).

The researches of M. Baber in Szetschuen and Yunnan, south-west China, brought him into communication with the Lolos, — an interesting tribe, who present but few points of agreement with the Mongolian type (pp. 26–28).

Dr. Hagen, on a journey inland from the east coast of Deli, in Sumatra, observed carefully the Battas of the coast, the Orang-Lussun of the foot-hills, and the Orang-Karo, Orang-Timor, and Orang-Tobah, in the vicinity of Tobah Lake. The writer dwells at some length upon their anthropometry and their social and technical characteristics (pp. 44–53, 102–104, 142–149, 167–177).

Mr. Fr. v. Schenck has added a little to our information upon the people of Colombia, South America, by references to the Antioqueños and Medellinos (pp. 85–93, 213–220).

A minute description of the inhabitants of the Jagnau valley, which lies near the 40th parallel, on the borders of Turkestan, is given by Bonvalot. These people are considered by Professor Fred. Müller to speak a very old Iranian language (pp. 93–102).

The archeology of Julianehaab, the most southern district of Greenland, first studied by Steenstrup in 1876, has more recently received the attention of Holm, who locates over a hundred ruins of Scandinavian dwellings, and who has examined many graves (pp. 137, 138).

Gerhard Rohlfs rates the number of Jews in Africa at 450,000: to wit, Algiers, 34,000; Egypt, 8,000; Tunis, 60,000; Tripoli, 100,000; Morocco, 200,000; the rest scattered over the continent (p. 211).

The names and localities of the African tribes living on the upper Niger, in Adamaua and the neighboring regions, is given by R. Flegels (p. 246). The accompanying chart is an excellent help in fixing definitely the location of each tribe.

Dr Emin Bey, governor of the equatorial provinces of Egypt in 1880, made a journey from Lado to Makraka, and in the following year prosecuted his researches through the Mudirié Rohl. Emin Bey's travels were mainly in the country visited by Petherick in 1862, by Schweinfurth in 1869–71, by Wilhelm Junkers in 1877 and 1878, and by Fekin and Wilson in 1879. This communication is illustrated by an excellent map, and contains much that is worth preserving about the tribes along the route (pp. 260–268, 323–340, 415–428). Dr. Junkers has a paper on his travels, in the journal, and describes especially the A-Madi (p. 286) and the A-Baranbo (p. 289) stock. Frequent references to Emin Bey and Junkers will be found in the bibliographic lists of the *Mittheilungen*.

The Rumuni, in Istria, are called by the Germans, Wallachs; by the Slavs, Wlaks; by themselves, Rumuni, or Rumeri. Dr. Karl Lechner devotes a few pages to a description of them (pp. 294–299).

Dr. Polakowsky makes the statement that Mr. Gabb's 'Tribes and languages of Costa Rica' has been published this year, with learned comments by L. Fernandez, as a special supplement of the Costa-Rican official gazette. The author also describes at length a visit of the Catholic bishop Thiel to the Chirippo, and other tribes of this Central-American state (pp. 300–304).

An excellent example of the application of graphic methods to anthropology is the nationality chart of Bohemia, designed by E. Hochreiter. Among the facts brought out and illustrated is the title which the Bohemians have won for being wanderers. While there are 490,565 Bohemians in Austro-Hungary outside of Bohemia, there are only 80,236 persons in that country who are not natives (pp. 321–323).

St. v. Rogozinski, visiting Liberia in March, 1883, gives a very flattering account of the state of affairs in that colony. Leaving Cape Palmas, he visited the coast of Assini, formerly a French colonial possession, but deserted in 1871. 'Of all the stocks of the west coast,' says Rogozinski, 'that I have seen, the Assinese are the most comely.' The court and village of King Amatifu made a very good impression upon the traveller; and he was able to acquaint himself with many of the customs of the people, especially those connected with the burial of the dead, the taking of meals, fetich doctors, and dancing. The journal of Rogozinski concludes with a brief recital of a visit to Elmina, in Ashanti, and the announcement of his arrival in Fernando Po (pp. 366–373).

Two papers descriptive of the upper streams of the Yang-tse-Kiang and the Taw-la Mountains, by N. Prjevalski, make incidental allusions to ethnologic subjects. The Jegrai and the Golyks (Kolö of Huc), of Tangut stock, find mention on p. 351; and the Tibetans are described at greater length on p. 379.

Notes on the customs of Kafiristan are to be found in the communication relating to that country, by Hughes and Munschi-Synd-Schah, especially on pp. 408, 409.

Supplement No. 71 is devoted entirely to the Cossacks. It is compiled from the work of Choroschchin and from other sources, by F. v. Stein. We have in this essay an excellent monograph upon the Cossacks, commencing with a brief *résumé* of their history, so far as it is known, and enlarging upon their present dispersion, characteristics, their works and industries, and chiefly their social and military organization. Upon the last point, carefully prepared statistics have been compiled.

Supplement No. 72 is a report of Juan Maria Schuver's journey to the upper Nile region, including his observations and discoveries upon the watershed between the Blue and the White Nile, and on the border-line between Egypt and Abyssinia. This number is replete with descriptions of the people in the districts considered.

Supplement No. 73 is a methodical investigation concerning the cinnamon-producing regions, by Dr. Carl Schumann. One of the many useful results of this study is its bearing upon the history of commerce.

SPENCER'S PHILOSOPHY OF THE UNKNOWABLE.

An examination of the philosophy of the unknowable, as expounded by Herbert Spencer. By WILLIAM W. LACY. Philadelphia, *Benjamin F. Lacy*, 1883. 4+235 p. 8°.

THIS is a work that will interest the student of our American civilization more than the student of philosophy. A man of extraordinary keenness and vigor of thought, plainly a born speculator, but utterly ignorant concerning some of the most elementary matters of physical science, devotes more than two hundred pages of close and ingenious argument to the task of refuting Mr. Spencer's well-known doctrine of the unknowable. The dead horse is flogged with a persistence that astonishes the reader, who has so often, ere this, seen the hopeless task tried without success. For the unknowable is once for all beyond the reach of harm, in the unapproachable regions of the unmeaning; and nothing that we can do or say has any sort of effect on its blessed repose. One might as well hunt snarks as to refute this portion of the Spencerian philosophy. If any refutations had or could have any value for the purpose, we could find enough of them in Mr. Spencer's own writings to content anybody. Quite recently, for example, at the close of an essay on the future of religion, Mr. Spencer has assured us that the 'scientific man' is possessed of an "analysis of knowledge, which, while forcing him to agnosticism, yet continually prompts him to imagine some solution of the great enigma which he knows cannot be solved;" and that this same man, "though suspecting that 'explanation' is a word without meaning when applied to this ultimate reality, yet feels compelled to think there must be an explanation." So that, to turn Mr. Spencer's confession into Saxon, his knowledge makes him feel pretty sure that he is talking nonsense about the unknowable, and yet forces him to keep on talking this nonsense. And this state of soul it is which the doctrine of the unknowable expresses; and the said doctrine is for Mr. Spencer not only very deeply religious, but also the last word of philosophy. Of course, when a man can put all this into print, over his own name, he has really done as much as any living creature can do in the way of refuting his own doctrine of the unknowable; and we can only thank him for his trouble. But surely we are absolved from writing books about this aspect of Mr. Spencer's views, at all events, however much his other views may be worth study or acceptance or refutation. Such passages being no new thing in Mr. Spencer's books, we therefore look with very languid interest on lengthy refutations like the present one, for we are convinced that some doctrines can well take care of themselves. Moreover, in its form, this refutation belongs to the past age of controversy, the age that culminated in Mill's 'Examination of Sir William Hamilton's philosophy,' — a time of far narrower range in philosophic study than our own, — a time whose problems were fewer and less fruitful, — a time, in short, when to read one or two books, and to show great ingenuity in close logical fighting, might have made any one a match in certain questions for even a great scholar and thinker like Mill. Such discussions we no longer desire. We read more in philosophy, we go to school to more teachers, we think of more problems; or else we have to be content to rank as mere amateurs in philosophy. Our author, like many other students of Spencer in this country, must, for all that we here see, be classed among the amateurs. Philosophy seems to mean to him a very few problems and lines of thought. If it were not so, how could he be content with such a form and range as this for his book? — a mere disputation, close, generally logical in form (save in the portions that touch upon physical science), abstract, dry, ingenious, laborious, but in outcome almost utterly fruitless.

Yet we said that the book ought to interest the student of our American civilization; and so it ought. Here is a man of no small native power, of no small application: he goes to the trouble, and doubtless to the expense, of printing this elaborate disputation of a purely theoretical question; he appeals, and can expect to appeal, only to a few, viz., to the special students of philosophy; he appeals to them with all the quiet assurance of a man who knows what he is about. There is a self-confidence in his manner, but there is no merely pretentious display of knowledge in his book. His style is Spencerian, — Spencerian with a bit more of vigor, and without a bit less of accuracy in form. The work is that of a mature thinker who has considered long and well. Now, however, this man has occasion to talk of the first law of motion. This law puzzles him. If a boy, he tells us, sets a ball going by hitting it with a bat, he himself is quite able to see why the ball is pushed by the bat so long as the bat is in contact with it, but thereafter he is perplexed. Why does the ball keep on moving? "Motion, in the absence of propulsion, is inconceivable;" that is, when the ball ceases to be pushed, it ought

to stop. But since, in fact, it keeps on, there must be a cause for this mysterious behavior. The cause the author thus describes: "Little as is known of the action of air and the ethereal substance, . . . and novel as is the thought of them as continuers of motion, no violence is done to the current understanding of their nature by imagining them as in the act of urging forward an object enveloped in them. The object cannot be made to move without causing much that is before it to move in the same direction, and much also to be dissipated laterally. Thus by opening a path is resistance lessened. . . . Now consider what must simultaneously take place in the rear. A space must be vacated by the object, and as quickly filled up by an in-rushing from all directions except that of the object. To the confluence of forces so formed, there is no outlet except in the direction of the object: consequently this direction they take, impelling the object forward" (pp. 59, 60). Thus it is that the ball moves: the air pushes it. It follows, of course, that no body would follow the first law of motion in a vacuum, and that air not only resists a body's motion, but also helps it to move; and so, in company with the various 'less stable substances' that exist in space, and of which, as we learn, 'there must be many besides heat and light,' the air or some other gas forms the necessary condition for the continuance of any motion. Much more talk of a similar sort follows, about inertia and gravity and like traditional conceptions, for which our author has new explanations, quite as clear and satisfactory as the foregoing.

Now, such passages illustrate the truth that the possibility of Keeley-motor investors also illustrates, a truth painful but indubitable; viz., that high intelligence, coupled with considerable learning, does as yet, in our enlightened land, neither prevent a man from having the wildest notions about the simplest matters of elementary physical science, nor enable him prudently to conceal his ignorance. There are shrewd and educated men to be found, who will invest money in impossible motors; and there are ingenious and not unlearned men to be found, who, like our author, will talk in such confused and ignorant fashion about the simplest matters of science, which ought to have been made clear to them in their schoolboy days: yet about other matters they do speak like men of sense. Their defect is not lack of mental power, but simply gross ignorance. Such speech at this time of day is disheartening. But possibly students of science, and more especially teachers of science, may do well to consider occasionally, in view of such ingenious rubbish as this, what a work they have yet to do, before the public mind is so well trained in elementary conceptions that nonsense like the foregoing shall be not merely nonsense, but impossible to men of our author's intelligence. Good elementary instruction in physical science is certainly very much needed; and here is an illustration of the need, — an extraordinary mind, condemned to seemingly hopeless error on important questions of the most elementary sort, all for the lack of a few hours of sensible teaching in boyhood or since. Meanwhile let the case serve as a warning to those who imagine that our American public is to receive useful instruction in elementary physical science from the now popular works of the great teacher of the evolution-philosophy. Here is a very good student indeed, diligent, logical, and ingenious. What philosopher could hope for a better? He has carefully studied Mr. Spencer's works, and this is what he has got out of them. If, he tells us, an object were pushed into an absolute vacuum with any velocity whatever, we are obliged by the necessities of our thought to suppose that this object "would therefore be stopped by the withdrawal of external influence." Such, Mr. Spencer may notice, is the effect of a use of the 'universal postulate' by a very devout student, who seems to accept so much of the Spencerian system without reserve. The effect of further doses of the 'universal postulate' upon our popular thought in America can only be conjectured. Deliver us from it, merciful powers!

It is only just to add, that Mr. Lacy, while rejecting the doctrine of the unknowable, is not opposed to the philosophic foundation of the positive Spencerian doctrines viewed generally, and finds his objections "not incompatible with estimation of the 'Synthetic philosophy' as perhaps the noblest speculative product of a single mind." We cannot do better than to leave the product and the worshipper in this happy attitude towards each other.

GEOLOGICAL SURVEY OF ALABAMA.

Geological survey of Alabama. Report for the years 1881 and 1882, embracing an account of the agricultural features of the state. By EUGENE ALLEN SMITH, Ph.D., state geologist. Montgomery, *W. D. Brown & Co., pr.*, 1883. 615 p. 8°.

THE law organizing the geological survey of Alabama requires from the state geologist, among other things, a report upon the agricultural resources of the state; and the present

volume has been prepared in obedience to this requirement: it is, in part, based on work undertaken by Dr. Smith in 1880, in the preparation of reports on cotton-culture in Alabama and Florida for the tenth census of the United States. The maps and woodcuts engraved for the census-office, and the statistics collected by the enumerators, were placed at his disposal for this report; while the geological material collected by the state survey during previous years was freely contributed to the census report on Alabama. Subsequently additional work has been done by the state survey for this report; and the resulting volume is most creditable, both to the ability of Dr. Smith, and the wisdom of the state in instituting such a survey.

Part i. of the report is introductory in its character, and consists of a general discussion of the composition, mode of formation, and properties of soils, and of the changes produced by cultivation. This discussion, extending over one hundred and fifty-three pages, is admirable of its kind. It does not attempt to present any original observations; but it is a very full and judicious *résumé* of the present state of knowledge on these topics, and shows a much greater familiarity with them than is usually expected from the geologist.

Part ii., which constitutes the report proper, is an account of the main agricultural features of the state of Alabama. Following the tabulated results of the census enumeration,—viz., table i., area, population, tilled lands, and cotton-production; and table ii., acreage and production of leading crops,—we find section i. devoted to an outline of the physical geography and geology of the state, and an enumeration of its agricultural subdivisions; section ii. giving a detailed description of these agricultural subdivisions; section iii., agricultural descriptions of the counties of Alabama; and section iv., cultural and economic details of cotton-production.

For the purposes of agricultural description, Dr. Smith divides the state into three divisions, — a middle, a northern, and a southern. Of these, the middle division is the oldest geologically, and consists of the south-western termination of the Appalachian chain; and the northern is the next in order, consisting of the southern termination of the great Cumberland tableland and of the highlands of Tennessee, together with the Warrior coal-basin. With the exception of bottom and alluvial lands, the soils of this division are sedentary soils, resting upon the rocks from which they were formed; and both the agricultural and topographical features of the country are largely determined by its geological structure.

In the southern division, on the contrary, these features are largely independent of geological structure, and "almost exclusively the result of erosion as determined by differences in the material of a single formation, — the stratified drift or Orange sand, which, except in parts of the prairie belt, covers the underlying beds over this whole division."

The soils of each of these regions are very fully described, the description being in many cases accompanied by chemical analyses and determinations of the more important physical properties. In the middle and northern divisions the classification is chiefly geological, while in the southern it is based mainly on the character of the prevailing forest-growth. A valuable addition to this portion of the report is a list of trees and lesser plants characteristic of the several regions of the state, prepared by Dr. Charles Mohr of Mobile.

The report is illustrated by three geological sections, an agricultural map of the state, and maps showing the distribution of temperature and rainfall for the year, and also for the winter and summer seasons.

LATE ELECTRICAL BOOKS.

Absolute measurements in electricity and magnetism. By ANDREW GRAY. London, *Macmillan*, 1884. 16+207 p., illustr. 24°.

Notes on electricity and magnetism. By J. B. MURDOCK. New York, *Macmillan*, 1884. 8+139 p., illustr. 16°.

MR. GRAY's book on absolute measurements is the outcome of a series of articles from his pen, upon the measurement of currents and potentials, published in *Nature* in 1882 and 1883: it is, in fact, a reprint of these articles, with some alterations and considerable and important additions; and it must be regarded as a most useful contribution to what may be called the *available* literature upon this subject.

The presentation of the systems of computation, based on the so-called absolute units, is clear and accurate, and will enable the student to obtain a firmer grasp upon the methods now all but universally used than can easily be secured from other sources.

The work opens with a description and discussion of methods of determining the horizontal component of the earth's magnetism, upon which so many electrical measurements are made to depend. Mr Gray is a warm advocate of the use of small masses in this operation, suggesting the use of magnets of

steel wire one millimetre in diameter instead of those found in the common form of magnetometer; and in the deflection experiment he uses the light mirror magnets which are found in Thomson's reflecting-galvanometer. In simplicity and convenience, his plan certainly possesses many advantages, as well as in freedom from certain errors which are likely to exist in the use of the more massive forms. It also has the merit of cheapness, enabling any one, at little expense, to determine this important element with a reasonable degree of accuracy. Neither method, however, is free from disadvantages, to which the author directs further attention in a note.

This discussion is followed by a consideration of the methods of calculating the constants of a coil, and the construction of a standard galvanometer, the latter being described with such attention to details as to leave little to be desired. The author then proceeds to explain the use of the standard galvanometer in the graduation of other forms, selecting for this purpose Sir William Thomson's potential and current galvanometers. The construction of these instruments is described, and the process of graduation which is actually adopted in practice. While it is doubtless true that instruments for the measure of current and electromotive force which satisfy all the demands of the practical electrician have not yet been devised, Sir William Thomson's unquestionably rank high among those at present in use. The most serious error which is likely to result from their employment arises out of the change in the strength of field produced by the permanent magnets, which is pretty certain to occur. Mr. Gray suggests several methods of testing the field of the magnets which furnish valuable checks in their use.

Two or three simple tests which are not referred to will readily suggest themselves to any one making use of the instruments.

The discussion of resistance-measurements, although not exhaustive, covers most of the ground; and especial attention is given to methods of measuring very low resistances, now a matter of greater importance than formerly. A chapter is devoted to the measurement of the energy in electric circuits, which includes a valuable discussion of the theory of alternating-machines and methods especially adapted to them.

One of the most interesting features of the book is a description of several simple and ingenious methods of measuring intense magnetic fields, suggested by Sir William Thomson; and also the use of earth-inductors in absolute measurements, as originally applied by Professor Rowland.

The closing chapter is devoted to a very satisfactory discussion of dimensional equations.

A list of errata accompanies the volume, and several errors not included therein are to be found; but none are of great importance, or likely to mislead the reader; and altogether the book will be welcomed by every student of electricity.

Mr. Murdock's notes are intended to be supplementary to the Elementary lessons in electricity and magnetism by Silvanus P. Thompson, and consist, in the main, of amplifications of some of the propositions in that work, with demonstrations in which a knowlledge of the elements of the calculus is assumed. Occasional extensions and additions are also made, which add much to the value of the book. It is likely to be of considerable use to the student of Professor Thompson's elementary lessons, and it may also be used alone with little difficulty. Errors are here and there met with, the most notable of which are to be found in the definitions of units, originating either in gross carelessness, or in a confusion of ideas in the mind of the author. The distinction between work and rate of work, or *activity* as it is happily named by Sir William Thomson, is not regarded in the definitions. A coulomb is defined as an ampère per second. A watt, which is activity, is defined as 10^7 ergs, which is work. The watt and joule are declared identical; although the first is activity, and the second is energy. The joule is defined as a quantity of heat: the suggestion of Sir W. Siemens was, that it should be a unit of work, equal to 10^7 ergs.

Thanks to the efforts of the British association and the international electrical congress, the nomenclature of electrical measurement is well-nigh perfect; and it is both important and easy for the student to acquire in the beginning clear and accurate conceptions of the nature and relations of the units involved. Is there not, however, a tendency at the present time to overdo the matter of creating and naming units? Too many will complicate rather than simplify processes of computation. The use of 'joule' does not seem to be altogether free from criticism, on account of the fact that the same name, or at least the initial *J*, has long been in use as the symbol for the mechanical equivalent of heat. There does not appear to be any good reason for making a unit of the current which will evolve one cubic centimetre of mixed gases per minute, and

calling it a 'jacobi,' as all derived units should be related to the fundamental units of length, mass, and time, through simple, decimal ratios.

There is danger, in fact, of the simple elegance of the absolute system being destroyed by excessive ornamentation; and it is well enough to make haste slowly in adding to what has already been done.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Paleontology. — Prof. H. S. Williams, from his preliminary study of the specimens he collected during last season in Genesee and Wyoming counties, N.Y., from the Genesee slate and Portage formations, reaches some interesting conclusions. He is convinced that the black shales which appear in the lower Portage of this region, and continue to appear as thin zones up to a point just below the Portage sandstones, represent merely an interrupted continuation of the deposits called the Genesee slates. After the typical Genesee slate was deposited to some considerable thickness, the Portage fauna made its appearance in the soft, blue, argillaceous shales. A hundred feet higher another black shale appears of several feet thickness, and then olive shales come in; and for several hundred feet this alternation continues, the black shales becoming thinner with each repetition, and containing an increasing amount of impurity, siliceous and argillaceous, so that in the upper part there are only dark-gray bands or streaks of the olive shales, with fine paper-like layers of black. The earlier Portage black slates bear the same fauna as the Genesee, but the specimens are fewer. Although these black slates are interstratified with the olive shales, they do not contain the Portage fauna. It is confined to the olive layers, and, higher up, to the bluish argillaceous shales. Near the top of the Portage series the sandstones come in. They are of a light-gray color, and are generally calcareous. They frequently have a petroleum-like odor. With them the Chemung fauna is associated. The lowest observed appearance of that fauna was in Java township, Wyoming county, in the first of the gray sands lying just above the last-observed black zone, which was bituminous.

Professor Williams also says that some interesting features have been revealed by the study of a large series of specimens of Spirifera mesocostalis Hall. In the representatives of the species from the upper Devonian, there is a well-developed median septum in the ventral valve, as in the genus Spiriferina; but the punctate character of the shell of that genus has not been observed in any of the specimens. The lower forms, at its first appearance in the Ithaca group, very rarely show any trace of the septum. As far as Professor Williams's examination has gone, he finds that the median septum is more fully developed and more generally present, the higher up the specimens are found. In harmony with this observation is the reference, by Mr. Whitfield, of a similar specimen from Wisconsin (Geol. Wisconsin, iv. 332) to Spiriferina under the name of Spiriferina (?) ziczac.

STATE INSTITUTIONS.

New-York state survey.

Rainfall of western New York. — To ascertain how much water is likely in different seasons to flow off of the surrounding watershed into Oak-Orchard Swamp, it was necessary to study with great care the rainfall of the western part of the state for the past fifty years. A careful analysis was therefore made of observations taken at Rochester university since 1830, and by the U. S. signal-service at Buffalo and Rochester since 1870. The result of this discussion of the Rochester rainfall is quite remarkable. It is shown, that from 1830 to 1880, during the very period when the woods were being cut off from the western part of the state, the rainfall steadily increased from a mean annual precipitation of 27.7 inches to 38 inches. The average was 34 inches. From 1868 to 1881 inclusive, there was the greatest average rainfall known for a similar period in that locality: it was 38.73 inches. The greatest recorded monthly, daily, and spring rainfalls occurred between 1870 and 1880. This decennial period is therefore a safe one from which to estimate maximum amounts of water likely to be discharged from watersheds in the western parts of the state; but towns whose future water-supply is estimated from the amounts received into lakes or streams since 1868 may find themselves very short of water, if the mean annual precipitation should decrease to that of the period from 1830 to 1840. Long periods of small average rainfall will doubtless recur in the region near Lake Ontario. The city of Rochester should be prepared for a time when, for ten years, the average yield of water from its present source of supply, the basin of Hemlock Lake, may amount to only three-quarters of the average flow from 1868 to 1881.

Quantity of water evaporated from various watersheds. — While the mean rainfall of this region has increased during the past fifty years, the summer flow of the streams has greatly diminished. This is due partly to the loss of retaining-power in the ground, owing to the removal of the soft forest mould, which in former times readily absorbed the rain and melting snows, and so prevented these invaluable waters from rushing off and wasting themselves in destructive floods, and partly to the enormous increase in evaporation. The proportion of rainfall, which, owing to evaporation, is lost for use in springs, lakes, and streams, is known to but few. In the special

report will be found a collection of observations on evaporation in this country and Europe. They show that large rivers receive in the main channels seldom more than one quarter of the average amount that falls on their watersheds. The remaining three quarters is evaporated. On small watersheds the proportion of loss from evaporation is small. The average flow into Croton Lake is about fifty per cent of the average rainfall on the gathering-ground, the area of which is 339 square miles.

The amount of water flowing from Cochituate Lake watershed, of 18.75 square miles, is, on the average, forty-five per cent of that which falls; but the proportion varies greatly from year to year. In 1866 only twenty-five per cent of the rainfall flowed into the lake; while in 1857, with almost the same rainfall, seventy-four per cent of the precipitation entered the lake. The difference in the amount evaporated in 1866 over that of 1857 was equivalent to a depth of thirty inches of water over the whole gathering-ground. Experiments made in Denmark and England show that the mean annual evaporation from soil and grass land is from twenty-six to thirty inches, or from fifty-six to sixty-seven per cent of the rainfall. The tables of rainfall and flow of the Sudbury River and Cochituate Lake show, also, that the summer evaporation amounts to eighty per cent of the rainfall on these basins; and that in March and April all the rainfall may flow off, together with a large amount of water from melting snow accumulated during the winter. The Sudbury River tables show that on this watershed the loss of water by evaporation between May and December is from three to four times the quantity lost in spring floods.

Effect of woods on the flow of streams. — The facts given prove that evaporation from the ground is the most effective cause controlling the summer and autumn flow in our streams: therefore whatever tends to retard evaporation will increase the summer flow of springs and streams. The great promoters of evaporation are heat, dryness of atmosphere, and wind. Woods, especially when the trees are large, act in three ways to prevent evaporation from the ground: they keep the surface cool, the atmosphere moist, and the lower stratum of air so still that the powerful drying-action of the winds is felt comparatively little. The amount of water which will be lost from any watershed by the removal of the woods must depend on the steepness of its slopes, the character and depth of soil, and the nature of the underlying rocks.

The greater part of the basin of the west branch of the Croton River is wooded. Its area is about twenty square miles. It yielded for four years an average flow of sixty-three per cent of the rainfall. The mean precipitation was 50 inches. The yearly evaporation was as follows: 15 inches, 11 inches, 23.6 inches, 15 inches. The Sudbury River basin in Massachusetts, containing seventy-eight square miles, is wooded over only from one-sixth to one-eighth of its area. From 1875 to 1879 inclusive, the mean annual rainfall was 47.7 inches, and the amounts of water lost, principally by evaporation, were 25 inches, 26 inches, 19 inches, 27 inches, 23 inches. The Cochituate basin is only partially wooded. Its average rainfall, 50 inches, is about the same as the West Croton and the Sudbury. The average yearly loss from the watershed is 27 inches, while in certain cases the evaporation alone must have exceeded 35 inches. The West Croton appears to yield in its flow some eighteen per cent more of the rainfall than the other watersheds mentioned; but the dissimilarity in their topography and geology makes it impossible to say how large a part the woods play in the differences of flow. Yet the result bears out the ordinary rule deduced from observations taken in Europe, that the average flow in streams draining wooded and swampy basins will be from sixty to eighty per cent of the mean rainfall, while those draining watersheds of undulating pasture and woodland generally receive into the main channel only from fifty to seventy per cent of the mean rainfall. Should the rule prove applicable in this country, the average increase of evaporation by the removal of woods from a district may amount to ten per cent of the annual rainfall. This loss will occur mainly in summer and autumn, so that the flow during this season will be diminished in far greater ratio.

With almost equal rainfalls (22.5 and 20 inches), more than two and a half times as much water (8.3 inches) flows from the wooded basin of the West Croton as is discharged from the comparatively unwooded watershed of the Sudbury River (2.9 inches) between June 1 and Nov. 1. During the remainder of the year the discharge from these two watersheds is almost the same. These results, being deduced from only four years of observation, would be modified by further measurement. The great difference in the flow from these two basins, since it is shown to occur between June and October, is undoubtedly due to a difference in the amount of water evaporated; and this is only partly accounted for by differences of topography and soil. The woods are surely playing an important part in maintaining the summer flow of the West Croton. Cutting them off might easily reduce the summer and autumn flow twenty-five per cent. While it must be understood that the facts are too limited to base any final results upon them, yet they indicate the probability that the summer and autumn flow of streams may be reduced in volume twenty-five per cent by cutting off the woods from their watersheds. If the summer and autumn flows in the upper Hudson, the Mohawk, and the Black Rivers, were lessened twenty-five per cent from their present average volume, the navigation of the Hudson and the canal would be doubtful; and certainly the loss in hydraulic power for manufacturing-purposes would be very great. While the people of New-York City are wisely taking an active interest in the protection of the northern forest, they should not forget that the preservation of the woods on the Croton watershed is of great importance in maintaining the summer water-supply of New York.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of natural sciences, Philadelphia.

March 11. — Professor Thomas Meehan made a communication upon a root said to be that of Conium maculatum, which was so virulently poisonous as to have quickly caused the death of a number of children who had eaten of it. In consequence of the rarity of Conium in the neighborhood, he was inclined to believe the species to be Cicutum maculatum, a common local plant, the root of which resembles that of Conium, but is not so dense. He proposed planting the roots with a view to making a further report on the subject when the leaves are sufficiently developed to place the specific characters beyond question. —— Mr. Edward Potts stated that the stems of Urnatella gracilis on the dry sponge-crusts recently collected had germinated after being placed in a life-case, showing that life persists in the stems during the winter, and makes itself manifest in the spring. He had found it somewhat difficult to work out the complete life-history of the polyp, in consequence of its being the prey of several associated forms of life. —— In a paper on the rufous or thatching ant of Dakota and Colorado, the Rev. Dr. H. C. McCook recorded the finding of the hills made by the species on the entire rolling prairie lying between the Cheyenne and the James Rivers. Specimens of the insect had also been sent to him from Iowa Gulch, near Leadville, taken from an elevation of 11,300 feet above the level of the sea. In its power to resist the vigor of the winter at high elevations, the American form resembles the Formica rufa of Switzerland, which is found as far up the Alps as the line of vegetation, farther progress being apparently limited by the lack of vegetable growth rather than by the cold. They may therefore be reckoned, both on this continent and in Europe, as among the most hardy of the ant-fauna, and best adapted to contend with severities of cold. Their hills in Dakota are, for the most part, conical elevations somewhat flattened at the top. Some present the peculiarity of a square base, giving the hill the appearance of a pyramid with a rounded top. Their height ranges from eight inches to a foot and a half. The largest mound observed was found near the summit of the Ute Pass. It was a conical heap, four feet long, and about one foot high, and looked like a small hay-stack, in consequence of its being covered or thatched, in common with all the others about Leadville and in Dakota, with bits of wood and broken sprigs of pine. As the colony increases its numbers, and the necessities of internal domestic economy require the enlargement of the formicaries, the excavated soil is brought up and laid on the thatching. In course of time a new roof of chips and clipped grass is overlaid; and thus, in the ordinary growth of a mound, there would be an alternation of earth and vegetable substance. The marriage-flight of the species takes place in the spring, with the first appearance of vegetation; and the swarms are a source of annoyance to the workers in the fields, although they do not get angry and rush at parties, attacking them, as bees do. The annoyance produced by such swarms is more than compensated for by a curious insectivorous habit of the ants, of which the settlers avail themselves to rid their clothing of lice. Garments so infected, left in the vicinity of the formicaries, are quickly and perfectly cleaned of both parasites and eggs, — a fact which was formerly well known to the Indians of the plains and to old pioneers and campers.

Natural science association, Staten Island.

March 8. — Mr. Seehusen read a paper upon gems, giving a description and history of the principal stones used as gems, with specimens to illustrate the notes. —— Mr. Leng read a paper upon the Coccinellidae of Staten Island, of which he recorded eleven species. —— Mr. Hollick remarked, that numerous specimens of the common seal (Phoca concolor) had visited the shores of Staten Island during the past month. If not disturbed, they would, no doubt, again return to the locality, and remain permanently with us, as do the sea-lions on the 'seal rocks' of San Francisco harbor, where they are protected by law. The speaker also remarked, that a single specimen of the great northern diver (Colymbus torquatus) had been noted in the bay, not far from the Staten Island shore.

Biological society, Washington.

March 8.—Dr. J .H. Kidder, U.S.N., exhibited specimens of Bacillus tuberculosus, and summarized the existing state of knowledge and opinions concerning its relation to tuberculosis. Dr. D. E. Salmon called attention to the claims of Toussaint as the discoverer of Micrococcus in tuberculosis, and remarked that the relation of Koch's B. tuberculosus to the disease is not yet certainly ascertained to be more essential than that of Micrococcus. —— Dr. D. E. Salmon exhibited specimens of infectious tuberculosis from cattle, in which he had been able to discover no traces of bacillus. —— Mr. C. W. Smiley read a paper on what fish-culture has first to accomplish. Fish-culture, he remarked, cannot be expected to perform what is impossible; namely, to fill the waters of a continent to overflowing with an inexhaustible supply of fish: on the contrary, it will have to put forth the utmost effort to prevent the entire annihilation of the fish-supply through the uncontrollable activity of the fishermen. —— Col. Marshall McDonald read a paper on the influence of temperature upon the movements of fish in rivers, in which the fluctuations of the catch of shad in the Potomac in 1881–83 were explained by reference to the varying temperature of the waters of ocean, bay, and river, at the time of their anadromous movements.

March 22. — Col. Marshall McDonald exhibited a chart showing the natural and restricted river-distribution of the shad. —— Dr. R. W. Shufeldt, U.S.A., offered some remarks on the patella, describing the position of this bone, which he considered to be a true sesamoid in various forms of mammals and

birds. —— Mr. Romyn Hitchcock exhibited a series of specimens of Orbitolites, and made some remarks upon the results of the work of Dr. William B Carpenter as finally set forth in vol. vii. of the report of H. M. S. Challenger. —— Prof. C. V. Riley presented some personal reminiscences of the late Dr. George Engelmann, which were supplemented by remarks from Dr. George Vasey and Professor Lester F. Ward. —— Mr. Richard Rathbun exhibited a large mass of coral (Oculina, sp.) recently obtained from Key West, growing on the end of a crowbar, which, when further studied, would probably yield some clew to the rate of growth of the species. —— Mr. M. G. Ellzey spoke on the prepotency of the male parent, giving the results of twenty-five years' experience in breeding horses, dogs, and other kinds of live-stock. The male parent he believes to be prepotent in the transmission of hereditary traits, except where some extraordinary circumstance intervened. In the case of hybrids between the horse and the ass, a cross is always marked by prepotency of the ass; and in all crosses of two species the male is always prepotent. Mr. Dall called attention to the danger of drawing conclusions from observations upon the external characters of the products of the union of two species. —— Dr. Leonard Stejneger exhibited two magnificently mounted specimens of the great Kamtchatkan sea-eagle, Thalassaetus leucopterus; also a specimen of the bald eagle, Haliaetus leucocephalus, and a specimen in immature plumage of another species, probably undescribed, and probably in the adult state entirely white. The rivers of Kamtchatka abound greatly in salmon, and eagles are in consequence particularly numerous.

Mathematical section, Philosophical society, Washington.

Feb. 20. — Mr. H. Farquhar showed the application of two kinds of empirical formulae to observations of the diminution of amplitude of a freely oscillating pendulum at different atmospheric pressures. When the amplitude and the time were connected by the equation of a hyperbola with four constants (the term involving the amplitude square being omitted), the observations could always be perfectly satisfied. The chief advantage of this form, however, was the ease with which the constants could be calculated from the observations by least squares. A formula more convenient in practical application gave for the time a constant, divided by the nth power of the amplitude; where n was a fraction proportional to the square root of the atmospheric pressure, and equal to about one-third for a pressure of thirty inches. The initial time, or time of an infinite amplitude, was a third constant to be determined; and it should be determined separately for all intervals within which the correction for amplitude is desired. Great nicety in the calculation of n was not necessary: the nearest tenth, or reciprocal, of a whole number, would suffice. The accuracy of this formula was shown by tables to be quite as close as the observations called for. When n became zero, the nth power was replaced by the logarithm of the amplitude, and the initial time was that of amplitude unity. The use of an empirical formula, of higher practical convenience than those usually adopted, — resulting from application of the theory that the diminution results from two resistances, proportional respectively to the velocity (or amplitude) and to its square, — was defended on the ground that this theory is itself empirical, and is well known to fail altogether for very high velocities. The proposed formula supposed in effect one resistance proportional to the $1 + n$ power of the velocity of the pendulum.

NOTES AND NEWS.

FROM *Nature* we learn that Sir Joseph Hooker has been nominated one of the vice-presidents for the Montreal meeting of the British association. Instead of Mr. Crookes, Prof. W. G. Adams will give one of the public lectures. For the Aberdeen meeting in 1885, Sir Lyon Playfair will be proposed as president. A well-attended meeting of the organizing committee of the chemical section has been held under the presidency of Professor Roscoe. Promises of papers were received from several well-known chemists, and a small executive committee was formed to draw up a list of papers, and to communicate with Canadian and American chemists. Section G has been particularly active. The committee has prepared a list of subjects for papers which it is thought would be interesting to English visitors if treated by engineers and mechanicians in Canada: a good supply of papers is expected, both from this country and America. Sir J. H. Lefroy has accepted the presidency of the geographical section. We regret to learn that Professor Williamson, the general treasurer, will be unable to be present; and the council have decided to engage the services of Mr. Hamy Brown as 'financial officer,' while Professor Burdon Sanderson has virtually consented to act as deputy for the treasurer at Montreal.

— The last number of the *Harvard university bulletin* contains further instalments of Mr. Winsor's bibliography of Ptolemy's geography and the Kohl collection of early maps; the former containing some very interesting comments on the knowledge of America about the middle of the sixteenth century, the latter relating exclusively to maps of the new world issued in the first half of the same century. Mr. Bliss's classed index to the maps in *Petermann's mittheilungen* will be completed in the next issue, and we may expect its separate publication in a few weeks. It will prove a great convenience.

— At the request of the navy department, the fish-commission steamer Albatross, Capt. Tanner commanding, was fitted out during the winter for the purpose of carrying on a series of deep-sea soundings and dredgings in the Caribbean Sea, a region very little known in respect to its depths. The vessel left Washington Jan. 1, and reached St. Thomas on the 17th, and, after coaling, proceeded on her voyage, making the following ports: Curaçoa, Trinidad, the Island of Oruba, Alta Vela, Jacmel, Gonaives, Santiago de Cuba, Navaza, and Kings-

ton (Jamaica), where she arrived March 1. She left Kingston March 11, and arrived at Aspinwall, *viâ* Savanillâ, March 25. On her return from Aspinwall she will proceed *viâ* Cape San Antonio to Key West, expecting to arrive at the Washington navy-yard about the middle of May. The expedition has been a great success in all respects; numerous satisfactory series of soundings and temperatures having been taken, and large numbers of marine animals obtained. In the collections incidentally obtained during the stop of the steamer at Trinidad were two specimens of the guacharo-bird, Steatornis caripensis, which is such a rarity in museums, and two of the great fishing-bat.

— The botanical collection of the late Charles F. Parker of the Philadelphia academy of sciences has been purchased for the Princeton herbarium. It is remarkably good as to the New Jersey flora.

— The report of the U. S. solar-eclipse expedition has just been ordered to be printed by Congress. Among its contents are, meteorology of Caroline Island, by Mr. Winslow Upton; botany of Caroline Island, collections by Dr. W. S. Dixon, U.S.N., and identifications by Prof. W. Trelease; notes on the zoölogy of Caroline Island, by Dr. W. S. Dixon, U.S.N.; memorandum on the butterflies, etc., of Caroline Island, collections by Dr. J. Palisa, identifications by Messrs. Herman Strecker and Arthur G. Butler; chemical constituents of the sea-water of the lagoon of Caroline Island, determined by Messrs. Stillwell and Gladding; observations of twenty-three new double stars, by Prof. E. S. Holden and Prof. C. S. Hastings; plans for work on the day of the eclipse, by Prof. E. S. Holden; reports on the eclipse; report in regard to the photographic observations of the eclipse, by Mr. H. A. Lawrance.

— Twenty-three years ago Mr. W. Nelson was in the habit of collecting fresh-water shells in a small pond near the Black Hills, Leeds. At that time only four forms were to be found there, — Sphaerium lacustre, Pisidium pusillum, Planorbis nautileus, and Limnaea peregra. After thirteen years an additional species, Planorbis corneus, made its appearance. These were the only species found there until the spring of 1883, when, to the surprise of the collector, six species previously unknown there made their appearance successively. This remarkable increase, which is well attested, took place without any apparent change in external conditions at the locality mentioned.

— After solving most of the knotty problems of molecular physics, the Rev. Dr. J. G. Macvicar departed this life, Feb. 12, from Moffat, Eng., aged eighty-three. He is reputed to have had some influence with Smithson in persuading him to establish the Smithsonian institution, and seems to have been much respected among his parishioners.

— An instance of the practical application of science to every-day life is well shown in the building of the capitol building of Dakota, at Bismarck, by the aid of electric light. This building, costing a quarter of a million of dollars, consists of three stories, basement, and sub-basement, measuring a hundred and fifty-five feet by ninety-two feet, and contains over four million bricks, with trimmings of Joliet stone, and has been erected in the midst of winter. The corner-stone was laid Sept. 5, 1883; and on the 10th of January, 1884, a few days more than four months later, a photograph shows the building to lack only the projection of one side and the upper part of the tower. This result was accomplished by the employment of electric light, which half the time replaced the sun, enabling double gangs of men to work day and night. The frozen sand was thawed by a red-hot cylinder; and the mortar, made with boiling water and hot lime, had its moisture absorbed by the dry bricks before it had time to freeze. Although taller, the building is an almost exact duplicate of the new capitol of Minnesota.

— The *Journal of the Society of arts* states that the coal-measures of New South Wales embrace an area of about 23,950 square miles. The seams worked vary from three feet to twenty-five feet in thickness, are nearly horizontal, and are in some localities considerably above sea-level. There are at the present time forty-one collieries at work, employing in the aggregate, above and below ground, 4,125 miners and others. In addition to the foregoing, there are two mines at which very valuable seams of petroleum-oil, cannel-coal, or kerosene shale are being worked. The number of men employed at these mines above and below ground is two hundred and thirty-one. Since 1865, when the working of these seams commenced, the output has been 241,284 tons, valued at £581,046. There are three principal coal-mining districts,— the Hunter River and Newcastle coal-field, situated to the north of Sydney; the Southern or Illawarra coal-field; and the Western or Lithgow coal-field, upon the Great western railway line, about ninety-five miles west from the metropolis. Coal is also being worked near Berrima, between Illawarra and Lithgow; and some seams are known to occur in the country lying between Lithgow and the Hunter River. Sydney, therefore, occupies an almost central position with regard to the coal-mining districts; and beyond these, coal has been discovered in different parts of the colony.

— Director Wild of St. Petersburg, as president of the International polar commission, has sent out invitations for the congress of arctic travellers in Vienna on April 22. The members of the expeditions sent out in August, 1882, by all the great states north of the equator, to make simultaneous observations of meteorological and magnetic phenomena, are expected to attend.

— Dr. George A. Groff has published a fifth revised edition of his 'Book of plant-descriptions, or Record of plant-analyses,' through the Science and health publishing company. It consists principally of a number of blanks to be used in the analysis of flowering plants, and for this purpose may be useful to teachers of small classes who do not wish to go to the expense of having blanks printed. There is also a list of terms used in descriptive botany, not, however,

accompanied by definitions. There is also a list of subjects suitable for theses, — rather an extraordinary array, on the whole, and requiring in a number of cases a much more elaborate equipment than that recommended on a previous page. The tabular view of the vegetable kingdom would better have been omitted altogether, as it is antiquated and faulty in several respects : desmids and diatoms are protophytes, and what coccoliths may be we are unable to say.

— Under the auspices of the Paris geographical society, a course of lectures is being given on the following subjects: Mr. Faye, The connection of astronomy and geography at the principal periods of history; Mr. de Lapparent, Reliefs of the globe; Mr. E. Fuchs, Distribution of minerals; Mr. Mascart, director of the weather-bureau, Climate; Mr. Velain, Glaciers, and their action on the reliefs of the globe; Mr. Bureau, Geographical distribution of plants; Mr. Ed. Perrier, The depths of the sea, and their inhabitants; Mr. Alphonse Milne-Edwards, Geographical distribution of animals. The first was given Feb. 11, and the last is put down for March 31. The course will be continued next year.

— From observations of the weather of the past seventeen winters, taken at Lawrence, Kan., by Prof. F. H. Snow, it appears, that, during this period, five winters have had a lower mean temperature and a larger number of zero days than the winter just closed, six winters have had a larger number of winter days, but only one has had a lower minimum temperature. The rainfall (including melted snow) of the past winter has been three-fourths the average amount; the fall of snow has been slightly above the average depth; the cloudiness has been more than two per cent above the mean; the wind has exceeded its average by more than five thousand miles; there has been a single thunder-shower (the average number); there has been one more fog than usual; and the barometer has exceeded its average height.

— Dr. C. V. Riley, of the Agricultural department of Washington, states that the rust which is often seen on oranges, and which decreases their market value by about a dollar a crate, is produced by a mite. He finds that this mite is very susceptible to sulphur and kerosene and milk, which, if judiciously applied early in the season, will preserve the brightness of the fruit.

— Mr. Francis Speir, whose address is South Orange, N.J., has sent out a circular, asking for replies to eleven sets of psychological questions, whose aim is " to cover the field of conscious mental activity in its relations with a possible unconscious cerebral activity." He desires to collect facts of personal experience from those who answer the circular, and to use these facts for the purposes of a classification and co-ordination of the phenomena.

The questions seem to us of very unequal value and definiteness. When Mr. Speir asks, " What is the greatest number of distinct ideas you can consciously have before your mind at one time ? " he asks a question that seems to us hopelessly vague. Wundt has tried to give such a question a definite meaning, and to investigate it systematically. Even his results seem to us somewhat ambiguous. For the ordinary observer of subjective states, the question may mean almost any thing or nothing; for what ideas shall he call distinct ? and what is one time ? Still, Mr. Speir may get some intelligible answers to this inquiry; but, as we venture to say, they will not all really refer to the same question. The question, " Can you wake precisely at a given hour determined upon before going to sleep ? " is an example of a definite and fair question. But to ask of people in general, " Have you ever dreamed a dream precisely like one your parents or ancestors have dreamed ? " seems to us to invite mere idle gossip. The answers, if negative, interest nobody: if they are affirmative, they might interest a collector of folk-lore; for, in telling his dream-experiences, who is very accurate at the best ? In remembering and repeating them over and over, who is free from the manifold errors of memory? But in comparing one's own dreams with the traditions of the dreams of one's grandmother, who will be able to give answers that can be called scientific? The more confident the reply, the less useful, in such a case, the supposed fact. There is a whole folk-lore of family traditions, as yet little known to science, because it is the private amusement of the fireside. Let us leave it all, for the present, to the poets, to the story-tellers, and to our aged female relatives. There are psychical facts nearer to observation, and less subject to whimsical, incalculable sources of error.

We suggest these criticisms because this work of collecting facts by means of psychological circulars is yet in its infancy, and its very life is threatened by any injudicious use of it. Mr. Speir's questions are, in the most of these cases, very fair; but the few injudicious ones endanger the success of his work. Plainly, in asking questions about subjective states, we are in perpetual danger of bad observations as the basis for the answers that we get. What are our safeguards ? Plainly, as Mr. Galton's success has shown us, the necessary safeguards are, to ask only perfectly definite questions, to ask questions in whose answer our subject has no disturbing personal interest, and to be careful not to ask questions that popular tradition has already answered by some poetical or otherwise interesting myth. Best of all are the questions whose answer our subject will never before have thought of at all, so that he will have no theory of his own. Unless we take some such care as this, our latest effort at the collection of psychological facts will degenerate into the most tedious of disastrous wanderings. We await with interest Mr. Speir's paper on the results of his inquiry, for most of his circular is promising enough.

— The following singular advertisement appears in the *Deutsch-Kroner zeitung* of Dec. 11: " Magpies shot between Dec. 24 and Jan. 6 are used for a remedy against epilepsy. The undersigned, with whom this medicine is prepared, will be greatly obliged to every one who will send him at that time as many magpies as possible, provided that they have been shot, and not killed by poison or caught in traps. — Castle Tütz, Dec. 5, 1883. Signed: Theodor, Count Stolberg."

SCIENCE.

FRIDAY, APRIL 11, 1884.

COMMENT AND CRITICISM.

A COMMITTEE of the Massachusetts legislature is considering the introduction of an act authorizing the preparation of a topographical map of the state. The U. S. geological survey commenced its work in the state last year by placing a surveying-party in one of the western counties, with the intention of constructing a map of the state, to be printed on the scale of about half an inch to the mile. The director of the survey has now proposed to the committee to double the printed scale, as well as the original plot, making the latter about two inches to the mile, provided the state treasury will bear one-half of the expense, or a sum estimated at five dollars per square mile, — a final total expense to the state (800 square miles along the coast being already charted by the coast-survey) of less than $40,000.

This recalls the movement in the state ten years ago, when the American academy memorialized the legislature for a general survey of the commonwealth, — a project which received the cordial support of scientific, industrial, and educational bodies throughout the state, and which was lost by the casting vote of the speaker of the house. That plan contemplated, on the topographical side, an original map, on the scale of 1 : 25,000, or about two inches and a half to the mile, to be finally printed on some lesser scale. The cost of the field-work was estimated at $25 per square mile, or $175,000. But the plan proposed so much more than the topographical map, that the estimated expense of the entire survey was brought to $385,000; and it was doubtless the magnitude of the total cost which finally defeated the measure.

Half a century ago, a trigonometrical survey was ordered and executed, and a small map prepared. The triangulation was admirably performed by Borden; but the map was a mere patchwork of town-surveyor's work, and, at best, showed only the superficial area, and no topography whatever. Yet it has been a boon to the state, and no one has ever complained of the expense. This survey cost $70,000 when the total valuation of the state was $200,000,000. The present valuation exceeds $2,000,000,000; and a present expenditure of $700,000 would therefore be the equivalent of what was granted to the first survey. An appropriation of $40,000 to obtain what, under any other circumstances, would cost at least $80,000, would be a mere pittance beside this; and it would seem that the reception of the last movement, involving so large an outlay, should encourage the committee of education to believe that the legislature would respond freely to the offer of the director of the government survey.

The difference between a scale of 1 : 25,000, asked for ten years ago, and that of about 1 : 31,680, now proposed, is not great enough to materially affect the delineation of the general topography, and of the distribution of such natural features as are most needed for industrial and scientific purposes. It is not all that could be desired; and provision should be made in any matured plan to enable the commissioners to enlarge the scale in any district which would be ready to pay the additional cost required, as well as to secure for the state a transcript of all original plots. What the state will eventually need will be a far more detailed map. But it is questionable under what auspices such a work should be done, and it is morally certain that it will not be done for a long time to come. And in any case, failure to co-operate now with the U. S. geological survey would be to lose the services of a reliable and experienced corps in a plan offering

specially economical advantages. It would, in short, be wasteful of the public purse.

THE recent glacial studies in the western states, mentioned in our notes, serve to call attention to more than their technical result. Important as this is, we believe a greater value lies in their standing as an example of non-professional work. A problem of the greatest interest has been successfully attacked, not by organized state surveys, but by persevering private enterprise, in time spared from regular pursuits; and success in such an endeavor is a hopeful sign of our progress toward the more popular and practical appreciation of theoretical geology, that has been fairly attained in England and Switzerland. We trust there may be many others working to the same end on the numerous problems that await them. The evidence found by Mr. Wright to suggest the former existence of a glacial dam across the Ohio, so as to form a long, irregular lake above Cincinnati, has been eagerly accepted by some of the Pennsylvania geologists to explain the high-level terraces farther up the river-valley. The southern shore-line of this hypothetical lake remains to be searched for, and, in connection with the physical history of the Ohio, forms a most attractive problem for detailed local study. The shore-lines of the Great Lakes, in the once expanded condition as marked by the lake-terraces, are also subjects for patient tracing from town to town. Scattered observations on them are already old. How long must we wait before local observers give a full picture of these inland seas?

IT is time for a reform in the relations existing between the public and the college-professor, as regards the asking and giving of advice on matters which are not educational in character. We suppose that every professor is willing to answer questions that pertain to education or to pure science, — not only willing, but glad to do so, if there is a fair prospect that the answer will be of real assistance; but it does not follow that he ought to answer questions bearing upon business-matters. Why, for instance, should a chemist known to us be expected to comply with such requests as, 'Please give me a sketch of Glinsky's dephlegmator?' 'Would *papier-maché* be a good substitute for leather in the manufacture of shoe-soles?' 'Please describe an easy method for making a complete analysis of water,' etc.; all of which, besides many others, have been received within a few days past? This amounts to asking for professional advice, and is to be compared with asking the advice of a lawyer or physician. No one expects these gentlemen to dispense their knowledge freely to all comers, and they are protected by the understanding that answers to professional questions involve pecuniary compensation. The clergyman is the only professional man, besides the professor, who is expected to give advice without compensation; but it is not probable that his advice in business-matters is often asked. Advice in spiritual matters he is, no doubt, ever ready to give, as the professor is in educational matters; but if, in addition to being a clergyman, he happened at the same time to be a physician or a chemist, it is not probable that he would feel it to be his duty to answer all questions pertaining to medical or chemical subjects.

The view of the matter here taken may appear to be a mercenary one, but that is not the point we wish to emphasize. We desire simply that the professor should be protected from unnecessary demands upon his time. If it were once understood that he is not expected to give free advice to any one who may care to ask for it, he would be saved a great deal of annoyance, and much time, which could, and presumably would, be put to better use. If the notion could once be spread abroad that a letter asking advice must be accompanied by a certain sum of money, most of the letters of the kind now written would never find their way into the mails, and the world would be the gainer in every way. A simple remedy for the difficulty complained of would appear to consist in ignoring the annoying letters; but experience has shown that this remedy, however simple it

may appear, is by no means satisfactory. The writer of the letter, in which he *may* have enclosed a stamp, though this is supposing an extreme case, receiving no answer, feels himself aggrieved, and writes again; so that in the end the receiver is forced to answer to protect himself. Is there, then, no remedy? Perhaps not. We nevertheless appeal to the public to bear in mind that the college-professor, however little he may have to do (and it is well known that this is very little), has at least something to do besides answering every question regarding business-matters in which it is thought that his advice may be of aid. Ask him any thing you please in the interests of matters pertaining to education or pure science, but draw the line when it comes to asking for what may fairly be called 'professional advice,' in the sense in which that expression is used by the lawyer and the doctor.

Two of the most unexpected discoveries in the deep-sea soundings during the last campaign of the Talisman, under the supervision of Prof. A. Milne-Edwards, are, first, the discovery of polished and scratched pebbles at a depth of five thousand metres, between the Azores Islands and the coast of France, indicating plainly the existence there of icebergs during the glacial epoch; and, second, of stones with impressions of parts of trilobites also brought up by the trawls. If these rocks with trilobites belonged where found, it will go far to prove the existence of an Atlantis continent during the secondary and tertiary epochs.

As a rule, one would not expect scientific knowledge to be much advanced, or very usefully diffused, by elegant extracts and quotations. But in a small book just issued by Appleton & Co., made up of 'characteristic passages from the writings of Charles Darwin,' Mr. Nathan Sheppard has really produced, in a form at once authentic, brief, and inexpensive, an instructive and very readable account of Darwinian doctrine in the words of its founder. The pieces are put together with no small skill, not in the order of publication, but rather in the order of evolution. It begins with the movements and habits of plants, rises from these to worms, discourses of the variation and struggle for existence of the higher living forms, and so to the highest, —

'The diapason closing full in man.'

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The relations of Didymodus, or Diplodus.

My reverence for the genius of Professor Cope is so great, and my confidence in his acumen so implicit, that when he assured me, first personally, and then in *Science* (iii. 275), that Didymodus (a substitute for Diplodus) was the proper name for Chlamydoselachus, I was willing to at least concede that the two forms might possibly be related. Knowing, as I did, that different types had been confounded under the name Diplodus, I was content to await the publication of Professor Cope's views before expressing a positive opinion, thinking he might have evidence in reserve which would gainsay what had been before offered. A *résumé* of Professor Cope's observations has just appeared, as promised, in the *American naturalist* for April (xviii. 412, 413), and we are therefore in a position to test his utterances. Notwithstanding the reverence and confidence that I have expressed, I can but think now, that for once Professor Cope has been too hasty, and tripped. I am convinced, not only that Didymodus has no generic nor even family relations with Chlamydoselachus, but that it represents even a different *order*. My belief in Professor Cope's candor equals my other sentiments, and I presume he will discard his first-formed opinion when his attention is called to certain facts.

The history of Didymodus, or Diplodus, is a long one, and is complicated with that of several others. I need only give the salient features.

In 1837 Professor Agassiz (*Poiss. foss.*, iii. 66) described a spine which he believed to have belonged to a fish like the sting-rays, as Pleuracanthus laevissimus. The only example was obtained from the Dudley coal-field.

In 1845 Professor Agassiz (*Poiss. foss.*, iii. 204) made known certain teeth, which he referred to sharks of the family of Hybodonts. Two 'species' were distinguished, D. gibbosus and D. minutus. Both were obtained from the English coal-measures.

In 1848 Professor Beyrich (*Berichte verhandl. k. preuss. akad. wiss.*, 1848) proposed the generic name Xenacanthus for a German carboniferous form referred to Orthacanthus by Goldfuss (1847), but which approached nearer to Pleuracanthus.

In 1849 Dr. Jordan (*Jahrbuch für min. u. geol.*, p. 843) described, under the name Triodus sessilis, a form subsequently ascertained to be identical with the Xenacanthus.

In 1857 Sir Philip de Malpas Grey Egerton (*Ann. and mag. nat. hist.*, xx. 423) contended that the spines of Pleuracanthus belonged to the same fish as the Diplodus teeth, and that Xenacanthus was likewise referable to the same type.

In 1867 Professor Kner (*Sitzb. k. akad. wiss.*, lv. 540–584) published an elaborate memoir, illustrated by ten plates, in which he proved conclusively

that Diplodus and Xenacanthus were generically identical.

In 1883 Professor Cope (*Proc. acad. nat. sc. Philad.*, p. 108) substituted the name Didymodus for Diplodus, because the latter name had been given in 1810 to Sargus by Rafinesque. The distinguished naturalist was evidently unacquainted with the researches of his predecessors.

There is much variation in the dentition of Pleuracanthus (as we shall now call Diplodus, or Didymodus), but it is rather a variation consequent on position in the jaws than specific or generic; and not only 'the species,' but one and the same species, may 'possess two, three, or four denticles,' but not teeth at all like Chlamydoselachus. However, somewhat analogous teeth are those of the type named Diplodus incurvus by Professors Newberry and Worthen (*Pal. Ill.*, vol. ii. p. 62, pl. 4, f. 4). These were very different from Diplodus, and belonged to a genus called Thrinacodus by St. John and Worthen (*Pal. Ill.*, vol. iii. p. 289, pl. 5, f. 1, 2). But whether the animals armed with such teeth resembled Chlamydoselachus may well be doubted.

In fine, the order called Ichthyotomi by Professor Cope appears to be demanded; but it has nothing whatever to do with the Pternodonta or Selachophichthyoidi, and it may not even belong to the selachians (some of its characters are very peculiar, and resemble those of protodipnoans). Further, the order had already been recognized, defined, and named by Lütken. Didymodus, or Diplodus, and Triodus, can be co-ordinated with the spines, Pleuracanthus, Orthacanthus (pt.), and Xenacanthus. All these names are referable to a single *family* (Pleuracanthidae) of the order Xenacanthini of Lütken. The proposed memoir of Professor Cope will, however, be a great boon to science; and to enable him to co-ordinate his data with those of the earlier paleichthyologists, and thus render it still more valuable, is the object of this communication. Apparently two genera, distinguished by their spines, exhibit the Didymodus, or Diplodus, dentition, — Pleuracanthus and Xenacanthus. Information is especially desirable respecting the character of their branchial apertures.

As to Chlamydoselachus, the anatomy will probably reveal a structure most like that of the Opistharthri (Notidanidae), but of a somewhat more primitive type. Mr. Garman's memoir will unquestionably be of great value, for probably no one is better acquainted with the selachians than that gentleman.

THEO. GILL.

The 'unit of time' controversy.

Upon reading your editorial comments in *Science*, No. 58, upon the 'change in the unit of time' controversy, which close with the words "Unless, then, this matter admits of speedy and permanent decision, the one way or the other, with the entire agreement of all parties to the controversy, astronomy would appear to run the serious risk of forfeiting her claim to a place among the exact sciences," it strikes me, that unless the whole thing is intended as a sarcastic criticism of Mr. Stone, of which there is no evidence, it is about time to call a halt upon some one for loose writing.

If Mr. Stone maintains that a mean solar day, instead of depending upon the actual time of rotation of the earth on its axis and the actual time of its revolution round the sun (and hence capable of determination by actual observation), is an arbitrary interval of time fixed by the dictum (of Bessel, Leverrier, or any other human being) that in that time the earth shall move so far in its journey round the sun (and that is exactly what his theory amounts to), and if he says,[1] "Professor Adams's argument, that 'mean solar time is measured, not by the sun's mean motion in longitude, as Mr. Stone's theory supposes, but by the motion of the sun in hour-angle,' is one that I do not profess to understand," and if he persists in maintaining these absurd positions, then astronomers will simply leave him to himself, for argument in such a case is useless.

As to the relation of astronomy to the exact sciences, let us see how much is the point in dispute. The increasing discrepancy between the formulae of Bessel and Leverrier for the annual mean motion of the sun in longitude is $0''.0602$ per year; that is, six-hundredths of a second of arc while the sun moves 1,296,028 seconds. This amounts to eight-hundredths of a second of time ($0^s.08$) in *twenty years*. Expressed as a ratio to the whole constant, it is .000,000,046, or about 1 part in 21,500,000. The discrepancy between the two best modern determinations — those of Hansen and Leverrier — is only $0''.0043$ per year, or about one-fourteenth of the above; and perhaps it will be admitted by even the most enthusiastic devotees of the 'exact sciences' that this is a fairly well determined astronomical constant. The proper theme for exciting astonishment should be, that Bessel, with the data available in his day, should have been able to determine this, and a dozen other constants, so wonderfully near their true values as modern observations show them to be. Only an intellectual giant of his wonderful skill and indomitable energy could have accomplished such results.

H. M. PAUL.

Washington.

[*Caeteris paribus*, loose writing is much less probable than loose reading. We counsel our correspondent to re-read, and with circumspection. *Science* hopes to present the views of all parties when so expressed as to merit a hearing, and, least of all, takes occasion to espouse the cause of a partisan. The controversy on 'the unit of time' is regrettable; but foreign astronomers are abundantly competent to conduct the discussion, as they have done heretofore, without additions to the literature of the subject on the part of any one here.]

The use of the method of limits in mathematical teaching.

Science for March 14 contains a letter by Professor Safford on methods of teaching the calculus, in which he refers to the 'new method of rates' by the writers, in comparison with the method of limits. The phrase, 'new method of rates,' is quoted from a list of subjects for discussion by the M. P. club, Boston, and was probably intended as an abbreviation of the title of a pamphlet, "On a new method of obtaining the differentials of functions, with especial reference to the Newtonian conception of rates or velocities."

We have more recently published a treatise on the differential calculus, founded upon the method of rates or fluxions, in which the method published in the pamphlet is employed in obtaining the differentials of functions, but which has nothing in common with the methods used by Maclaurin, except the employment of the conception of velocity in the fundamental definitions.

Professor Safford regards the doctrine of 'the survival of the fittest' as having pronounced against the method of fluxions, and in favor of the method of limits. It seems to us that it is rather the *geometrical methods* of Maclaurin and the immediate followers of Newton that have thus been condemned, as com-

[1] *Monthly notices*, January, 1884, p. 81.

pared with the analytical methods and more flexible notation adopted by the followers of Leibnitz.

The Leibnitzian notation, although originally connected with the doctrine of infinitesimals, has now been universally accepted; so that we must inevitably denote an absolute velocity by $\frac{dx}{dt}$, and a relative velocity by $\frac{dy}{dx}$. The question which is still, as it seems to us, debatable, is whether these symbols shall be defined (1°) by the conception of a velocity, (2°) as limits of finite differences, or (3°) as the ratios of infinitesimal differences. The second course arose as a protest against the logical difficulties involved in the conception of infinitesimals: it labors under the disadvantage of attaching no separate meanings to the symbols dx, dy, and dt, and thereby loses much of the advantage of the Leibnitzian notation. This method is best exemplified in the excellent treatise of the late Dr. Todhunter. On the other hand, the employment of the notion of rates in the fundamental definitions enables us to give to the detached symbols dx, dy, and dt, definite meanings which are not of necessity infinitesimal.

It appears to us that this method of presenting the subject is better adapted than that of limits to the purposes of elementary instruction. We do not attempt or desire to dispense with the use of limits, as the following quotation from our preface will show: —

"The distinction between the view of the differential calculus here presented, and that found in most of the standard works on the subject hitherto published, may be stated thus: the derivative $\frac{dy}{dx}$ is usually defined as the limit which the ratio of the finite quantities Δy and Δx approaches when these quantities are indefinitely diminished. When this definition is employed, it is necessary, before proceeding to kinematical applications, to prove that this limit is the measure of the relative rates of x and y. In this work the order is reversed; that is, dx and dy are so defined that their ratio is equal to the ratio of the relative rates of x and y: and in chapter xi., by applying the usual method of evaluating indeterminate forms, it is shown that the limit of $\frac{\Delta y}{\Delta x}$, when Δx is diminished indefinitely, is equal to the ratio $\frac{dy}{dx}$. Thus the employment of limits is put off until we are prepared to show that the limit has a definite value, capable of expression in a language already familiar to the student."

Our experience has been, that the student trained by this method finds no difficulty in passing to the employment of infinitesimals, in obtaining the differentials which are required in the mechanical applications of the integral calculus; for example, those required in the determination of moments of inertia, resultant attractions, etc.

J. M. RICE.
W. W. JOHNSON.

U. S. naval academy.

Silk-culture in the colonies.

In your review of my census report on silk-manufacture in the United States, your critic takes issue with me as to the amount of silk raised in the colonies. He declares that there is a tendency on my part "to depreciate the quantity and quality of silk produced, — a tendency which is natural, and doubtless unconscious in an agent of manufacturers." In support of this grave imputation, your critic adduces two points on which he disputes my proof that certain estimates, hitherto accepted as relating to raw silk, really refer to cocoons, and probably to fresh cocoons. He says, first, that I by no means make it clear that the term 'raw silk balls' really meant cocoons, "as it might apply to the twisted hanks of reeled silk, and the term 'cocoons' was in use at that time." To this it need only be said, that, in the literature of the colonial period, cocoons are frequently designated by the term 'balls,' or 'silk balls.' For instance: —

"Removing your branches from the tables, and your silke-balls or bottomes from the branches 5 dayes after the worke is perfected, the balls are then to be made election of for such seed as you will preserve for the year following. Bonoeill and De Serres do both agree that there should be proportioned 200 balls for one ounce of seed, the balls male and female."

On the other hand, in a widely extended reading on the subject, I have never met with the term 'balls' as signifying reeled silk in any form; and I have no reason to believe that reeled silk was made into balls.

Your critic remarks, secondly, "It is certainly not justifiable to assume that the cocoons were necessarily fresh, as they are not thus handled and marketed." They are so handled and marketed at the present day. Statistics of production in European countries and districts are compiled, based on the weight of fresh cocoons. The commerce in them is very large. Quotations of their market-prices appear, during the season, in trade reports and journals. For instance: in the *Moniteur des soies* of June 30, 1883, under the headings 'Prix des cocons Français' and 'Marchés des cocons Italiens,' there are pages of this sort of information; and it is so well understood as referring to fresh cocoons, that no special designation is used for them: they are simply 'cocons.' Indeed, I am assured, on good authority, that it is only fresh cocoons that go from the producers to the filatures: even if 'choked,' they are accounted fresh.

Is it not justifiable to believe that estimates of the weight of cocoons produced in Georgia, and of what was sent to the filature there, were similarly made; that is, that they referred to fresh cocoons? This view of the case came to me only after months of research and final good fortune in tracing the origin of an historical error. Until then, I had accepted without question the current histories in their accounts of silk production in the colonies. My explanation reconciles their strange discrepancies: before refusing it, should not some other solution be offered?

While differing wholly from the conclusions of your article as to the causes of failure and cessation of silk-culture in this country, I should not have troubled you with a reply to criticisms on my work, had they not contained the imputation to which, with great regret, I have deemed it necessary to refer.

WM. C. WYCKOFF.

Rainfall at Amherst, Mass.

The month of February, 1884, stands alone upon the meteorological record of Amherst college in showing an average cloudiness of seventy-seven per cent of the sky. During the forty-two years which this record covers, in no previous case has the cloudiness of a month averaged more than seventy-four per cent; in only five cases has it reached seventy; the range generally being between forty and sixty, and the mean almost exactly fifty.

The fact that clouds and fog gather only in air containing particles of dust, which has been scientifically demonstrated, suggests the question, whether the volcanic dust from Krakatoa, which in higher air gave to us the brilliant evening skies of December last, may not, in its gradual descent toward the earth, have reached in February the lower level, in which our clouds are formed, and have been the cause of this unprecedented accumulation of them.

S. C. SNELL.

Amherst, Mass.

Dr. Newberry's work in the Colorado Cañon.

My attention has been drawn to the fact that the absence of any mention of the earlier explorations of the Colorado Cañon region in the review of Capt. Dutton's monograph (p. 327) does an apparent injustice to these, and particularly to Professor Newberry's work in that district. It is to be regretted that the limit of space available rendered an historical notice of the progress of geological discovery in this remarkable region impossible, while a paragraph in the review, intended to apply merely to the work of the later geological surveys organized as such, may be interpreted as ignoring that of previous government expeditions which antedated these by many years, and were carried out in the face of difficulties and even dangers with which later parties have not had to contend. This was very far from being the intention; and, indeed, Professor Newberry's work in the cañon region is so well known to geologists, and so highly appreciated, that an attempt to ignore it in any complete account of the region could but reflect on the author. THE REVIEWER.

The occurrence of the Hessian fly in North America before the revolution.

The American philosophical society of Philadelphia appointed, in 1791, a committee for the purpose of collecting, and communicating to the society, materials for the natural history of the insect called Hessian fly, as also information of the best means of preventing or destroying the insect, and whatever else relating to the same might be interesting to agriculture.

At a meeting of the committee, April 17, 1792, it was resolved, that for obtaining information of the facts necessary for forming the natural history of this insect, *before its entire evanishment from among us*, it be recommended to all persons whose situation may have brought them into acquaintance with any such facts, to communicate the same by letter, addressed to Thomas Jefferson, esq., secretary of the state to the United states.

Nine questions were proposed, on which information was particularly wanted. I quote here only the first.

"In what year, and at what time of the year, was this animal observed for the first time? Does it seem to have made its appearance in this country only of late years, or are there any reasons for supposing that it was known in any part of the United States previously to the commencement of the late revolution?"

The resolutions of this meeting are printed in full in Carey's *American museum* (Philadelphia, 1792, vol. xi., June, pp. 285–287) by the committee, — Thomas Jefferson, B. Smith Barton, James Hutchinson, Caspar Wistar. The *American museum* was discontinued after 1792. The last volume contains no report of the committee.

As is obvious from the first question, it was at this time not settled whether the insect had been observed here before the revolution, or not. Mr. A. Fitch quotes the publication in the *American museum*, and stated that no report had been made by the committee. The importance of this question, and of a committee with Jefferson at the head, led me to ask Prof. J. P. Lesley whether the old minutes of the Philosophical society contain any unpublished report, or any thing else relating to the Hessian fly. I received from Mr. Henry Phillips, jun., secretary of the society, the following answer, under date of March 28, 1884: —

At the request of Professor Lesley, I have examined our old minutes in reference to the Hessian fly, and append on next page the results of my search. I know *positively*[1] that before the revolution our newspapers are full of communications in reference to the Hessian fly *eo nomine*. I cannot recall to mind any one paper, but I remember perfectly frequently seeing these articles when reading for other purposes. I cannot find that the committee ever reported.

Extracts from the minutes.

1768, May 18. Com. on husbandry to consider whether any method can be fallen upon for preventing the damage done to wheat by the Hessian fly. *N.B.* — Mr. DuHamel has written on the subject.

1768, June 21. Paper on the Hessian fly read by Dr. Bond; ordered to be published. See No. 4, original papers.

1768, Oct. 18. Col. Landon Carter, Sabine Hill, Va. Observations on the fly weevil destructive to wheat; ordered to be published. [Is published in vol. i. of the transactions of the society. Cf. Harris, Injur. ins., p. 502. DR. H. A. H.]

1791, April 15. Jefferson, Dr. Barton, Hutchinson, Thomson, and Dr. Wistar, a committee to collect materials for forming the natural history of the Hessian fly, and the best means for its prevention and destruction. [Do not find this committee ever reported. H. P.]

1791, Aug. 19. Memoir on Hessian fly by T. L. Mitchell of Long Island read.

[1] The Italics are by Mr. H. Phillips.

Everybody conversant with our actual knowledge and the literature on the Hessian fly, will acknowledge it to be excusable that I took the liberty to again ask Mr. Phillips if by chance the year 1768, together with the name Hessian fly, was not a clerical error; the more so, as Mr. Morgan in Dobson's Encyclop. (vol. viii. p. 491) states, "The name of Hessian fly was given to this insect by myself and a friend early after its first appearence on Long Island."

To day I received from Mr. Phillips the following letter, dated April 1, 1884: —

1. 1768 is not an error. It occurs in the proper place in the old MS. vol., and there can be *no doubt* about the fact. *Similiter* the words *Hessian fly*.

The term came in use in Pennsylvania from the early German immigrants long before the revolution. I am *sure* the term occurs in our Pennsylvania gazettes long prior to that period.

2. Cannot say if that paper (of Dr. Bond) was ever published. Possibly in some gazette *pro bono publico*. There is no clerical error as to the date and name.

Dobson is certainly incorrect in the statement you quote. [Mr. Morgan's pretension to have given the name Hessian fly. Dr. H. A. H.]

At this writing it is not an easy matter for me to *verify* my own statement as to the communications which I have seen in the early Pennsylvania gazettes before the revolution. I have had great use often in days past for historical researches, and the recurrence of the name of the Hessian fly in these early days was a frequent matter of conversation with me and friends, friends of two generations older than myself. While I am perfectly convinced that my memory is accurate, yet a statement of that nature should be verified for historical use. I regret I have not the present opportunity of so doing; yet, in view of the minutes of 1768 bearing upon the matter, I don't doubt the accuracy of my memory, although it was *obiter*.

The importance of these letters is an excuse for their publication, which is done with the permission of the writer. DR. H. A. HAGEN.

Cambridge, April 2.

A spider's device in lifting.

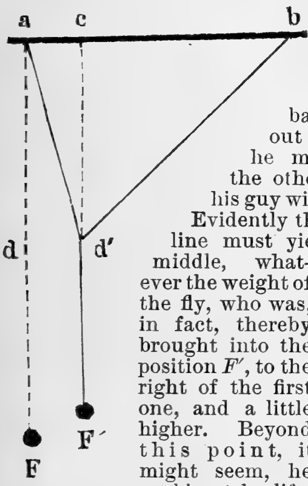
The interesting description by Mr. Larkin (*Science*, No. 58) of the lifting by a spider of a large beetle to its nest reminds me of quite another device by which I once saw a minute spider (hardly larger than the head of a pin) lift a house-fly, which must have been more than twenty times its weight, through a distance of over a foot.

The fly dangled by a single strand from the cross-bar of a window-sash, and, when it first caught my attention, was being raised through successive small distances, of something like a tenth of an inch each; the lifts following each other so fast, that the ascent seemed almost continuous. It was evident that the weight must have been quite beyond the spider's power to stir by a 'dead lift;' but his motions were so quick, that at first it was difficult to see how this apparently impossible task was being accomplished. I shall have to resort to an illustration to explain it;

for the complexity of the scheme seems to belong less to what we ordinarily call instinct than to intelligence, and that in a degree we cannot all boast ourselves.

The reader who questions the propriety of the last remark may be invited to pause, before hearing the spider's device, to consider how *he* would proceed to lift a whole ox hanging vertically beneath him at the end of a hundred-fathom cable, if he had no appliances whatever except some spare rope.

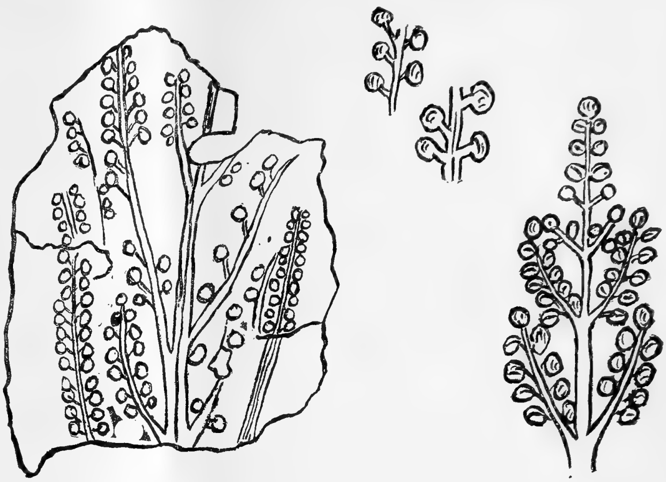
The little spider proceeded as follows (*a b* is a portion of the window-bar, to which level the fly was to be lifted from his original position at *F*, vertically beneath *a*): the spider's first act was to descend halfway to the fly (to *d*), and there fasten one end of an almost invisible thread; his second, to ascend to the bar and run out to *b*, where he made fast the other end, and hauled on his guy with all his small might. Evidently the previously straight line must yield somewhat in the middle, whatever the weight of the fly, who was, in fact, thereby brought into the position *F′*, to the right of the first one, and a little higher. Beyond this point, it might seem, he could not be lifted; but the guy being left fast at *b*, the spider now went to an intermediate point (*c*) directly over his victim's new position, and thence spun a new vertical line from *c*, which was made fast at the bend (at *d′*), after which the now useless portion *a d′* was cast off, so that the fly now hung vertically below *c*, as before below *a*, *but a little higher.*



The same operation was repeated again and again, a new guy being occasionally spun, but the spider never descending more than about halfway down the cord, whose elasticity was in no way involved in the process. All was done with surprising rapidity. I watched it for some five minutes (during which the fly was lifted perhaps six inches), and then was called away. L.

Two species of tertiary plants.

In looking over the plates of Mr. L. Lesquereux's Tertiary flora (U. S. geol. and geogr. surv., F. V. Hayden in charge), I noticed on plate xiv. a figure which seemed to have a familiar appearance. It was like the fruiting-frond of a fern, but the explanation called it Caulinites fecundus, Lesqx. The description on p. 101 referred to it as probably representing the undeveloped flowers of some palm. Turning to Gray's Botany, plate xviii., I was struck with the resemblance between his figure of Onoclea sensibilis and that given by Mr. Lesquereux. I have shown the two species side by side in fig. 1, and there is no doubt in my mind that the Caulinites fecundus is nothing but a part of the fertile frond of Onoclea sensibilis.



a, Caulinites fecundus, Lesqx. Fig. 1. *b*, Onoclea sensibilis, L.

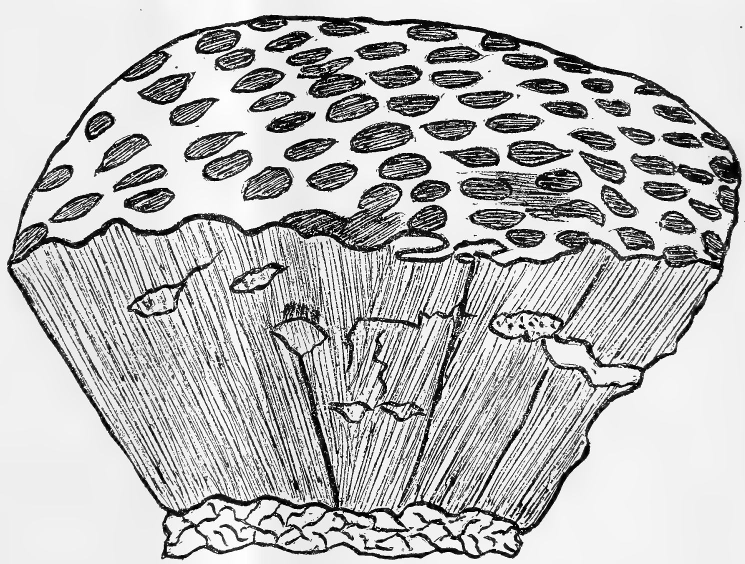


Fig. 2.—Zamiostrobus mirabilis, Lesqx.

In the Annals of the lyceum of natural history, New York, vol. ix. p. 39, Dr. Newberry records the finding of the sterile fronds of Onoclea sensibilis in strata of miocene age at Fort Union, Dakota. He considers that "there is little room for doubt, . . . that during the miocene age a species of Onoclea flourished in the interior of our continent, of stronger habit than either of the living varieties, and holding a mid-

dle position between them." He has based his determination of the species upon the sterile fronds only; but in the figure of Lesquereux we have the fertile frond, or a portion of it, of the same species. This fragment was found at Erie, Col. Should not the Caulinites fecundus be considered Onoclea sensibilis?

On plate lxiii. of the same volume we have a fossil called Zamiostrobus mirabilis, and on p. 70 is the description. Mr. Lesquereux has referred the fossil to the Gymnospermae, and considers it probably to be the cone of one of the Zamieae. Compare, now, the copy of his figure (fig. 2) with that of the longitudinal section of the fruit of Nelumbium luteum (fig. 3), and the resemblance is striking, — so striking is it,

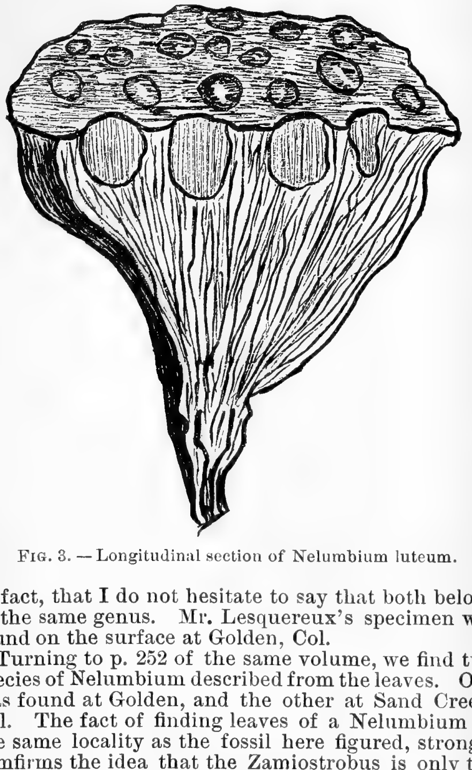


FIG. 3. — Longitudinal section of Nelumbium luteum.

in fact, that I do not hesitate to say that both belong to the same genus. Mr. Lesquereux's specimen was found on the surface at Golden, Col.

Turning to p. 252 of the same volume, we find two species of Nelumbium described from the leaves. One was found at Golden, and the other at Sand Creek, Col. The fact of finding leaves of a Nelumbium in the same locality as the fossil here figured, strongly comfirms the idea that the Zamiostrobus is only the capsular fruit of a Nelumbium, probably that described as N. Lakesii. It differs only slightly from the other species, N. tenuifolium; and the two should probably be united. JOS. F. JAMES.

Spool-shaped ornaments from mounds.

As the spool-shaped copper ornaments occasionally found in mounds — one of which is figured by Dr. Rau (*Arch. coll. U. S. nat. mus.*, p. 61, fig. 235), and others by Professor Putnam (*Rep. Peabody mus.*, xv. 110, figs. 18 and 19) — have attracted the attention of archeologists, it may not be amiss to notice some additional specimens of the same kind, recently obtained by the assistants of the bureau of ethnology.

Three of these were obtained by Dr. Palmer, of Mr. J. D. Miller, Marshall county, Ala., who discovered them in an ancient grave in that county. As yet no description of the grave, nor any further statement as to the conditions under which they were found, has been obtained.

These copper spools, as also the others to be mentioned, are of the form represented in the figures alluded to, consisting of two concavo-convex disks joined together by a hollow cylindrical axis. One of the specimens is quite perfect. The disks are one and a half inches in diameter, formed of copper plate that is very smooth and even throughout. The hollow cylindrical axis is about seven-tenths of an inch long, and a little less than two-tenths of an inch in diameter, and has the ends slightly expanded outside of the disks, so as to hold the latter in position. The other specimens found by Mr. Miller are of larger size; being about two inches in diameter, and closely resembling that figured by Professor Putnam. The plate is not more than half the thickness of that of which the preceding specimen was made, being almost as thin as writing-paper; but the cylindrical axis is of the same form and dimensions.

The method of connecting and fixing the disks in these, as will be seen from the description, is slightly different from that described by Professor Putnam. The cylindrical axis is simply passed tightly through the holes made in the centre of the disks, and the ends expanded, as though done with a punch, so as to clasp the outer faces.

Four other specimens, very similar to that figured by Professor Putnam, were discovered by Mr. Middleton in a mound in Jackson county, Ill. The mound in which these were found is one of a group situated in the Mississippi bottom, a short distance from Grand Tower: it is about ninety feet in diameter, and six feet high. In excavating it, human bones were found at all depths, from six inches to six feet below the surface. Below this no human bones were observed; but at the depth of nine feet, that is, three feet below the original surface of the ground, some animal bones were discovered.

The copper specimens were found at the depth of three feet, lying by the side of a skeleton. The four are of the same form and size, being about one inch and a half in diameter: the axis is short, bringing the disks rather closer together than usual, the attachments being as described by Professor Putnam. All the specimens mentioned, except the first, are much corroded and very brittle. The first is also somewhat corroded, but not to the same extent as the others, and is probably the best formed and most perfect specimen of the kind so far discovered. CYRUS THOMAS.

[These so-called 'spool-shaped ornaments' have been shown by Mr. Putnam to be enormous ear-studs, his examinations of the altar-mounds in Anderson township, O., having brought to light over thirty made of copper, together with figurines in which similar objects were *inserted in the ears*. See *Science*, i. 348, 349.]

Unio forms a byssus.

If your correspondent at Holston River, Va., will consult my 'Observations on the genus Unio,' he will find most of his queries answered. The subject is treated in vols. i., iii., vi., x., xi. The byssus is not attached to the shell, but to the foot of the included soft parts. ISAAC LEA.

Philadelphia, March 24, 1884.

Illusive memory.

James Sully, in his 'Illusions,' suggests that a good way of testing for recollections of ancestral experience would be to find out whether children of seafaring men, who have been brought up far from the coast, have the feeling, when they first see the sea, of having seen it before.

Paul Radestock seems to consider that the question is settled by the fact, that while he was writing his

book, 'Schlaf und Traum,' and keeping a record of his dreams, whenever he had a dim idea that he had seen an object or had a thought before, he generally found that his dreams had contained something like it. But he overlooks the consideration that the dream, as well as the feeling, might have been a case of inherited recollection. C. L. F.

Baltimore, March 24.

The reproduction of Clathrulina elegans.

An article with this title (*Science*, iii. 303), by Dr. Stokes, contains two errors, to which his attention is courteously directed, and which are evidently founded upon an incorrect abstract of Miss Foulke's paper. Dr. Stokes says Miss Foulke's statements are "apparently confined chiefly to a process by quadruple subdivision of the body into uniflagellate organisms as observed by herself, with allusions to three additional processes as observed by others." Of the four processes described by the writer, three were first described by her, the fourth being that described by Cienkowski. Again: in the last paragraph is an error resulting from the position of the quotation-marks, which would seem to classify one of the writer's observations with those of Dr. Stokes. Colonies are also formed by the Actinophrys form of young, and the dissemination of the species is carried on as well by the uniflagellate as by the bi-flagellate organisms. These observations should teach us how varied may be the forms assumed by one animal.

SARA GWENDOLEN FOULKE.

WHAT IS A LIBERAL EDUCATION?

I DO not intend, in the present paper, to enter upon the disputed question between the advocates of classical culture on the one hand, and those of scientific training on the other; because it seems to me that the line on which the two parties divide is not that which really divides the thought of the day. If we look closely into the case, we shall see that the objects of a higher education may be divided into three classes, instead of the two familiar ones of liberal and professional. In fact, what we commonly call a liberal education should, I think, have two separate objects. With the idea of a professional education we are all familiar: it is that which enables the possessor to pursue with advantage some wealth-producing specialty. Although, in accordance with well-known economic principles, it is designed to make the individual useful to his fellow-men, the ultimate object in view is the gaining of a livelihood by the individual himself. On the other hand, the object had in view in what is commonly known as culture, is not the mere gaining of a livelihood, but the acquisition of those ideas, and the training of those powers, which conduce to the happiness of the individual. From this point of view, culture may be considered an end unto itself.

The third object which we have to consider is only beginning to receive recognition in the eyes of the public. It is the general usefulness of the individual, not merely to himself and to those with whom he stands in business relations, but to society at large. Modern thought and investigation lead to the conclusion, that man himself, the institutions under which he lives, and the conditions which surround him, are subject to slow, progressive changes; and that it depends very largely on the policy of each generation of mankind whether these changes shall be in the way of improvement or retrogression. During the next fifty years all of us will have passed from the stage of active life, and the course of events will be very largely directed by men who are still unborn. The happiness of those men is, from the widest philanthropic point of view, just as important as the happiness of those who now inhabit the earth; and, in the light of modern science, we now see that that happiness depends very largely upon our own actions. We thus have opened out to us an interest and a field of solicitude in which we need the best thought of the time. The question is, what form of education and training will best fit the now rising generation for the duty of improving the condition of the generation to follow it?

Let it be understood that we are now speaking, not of the education of the masses, but of that higher education which is necessarily confined to a small minority. So far as I am aware, that fraction of the male population which receives a college education is not far from one per cent. To that comparatively small body we must look for the power which is to direct the society of the future, and by their acts to promote the well or ill being of the coming generation. Our duty to that generation is to so use and train this select body as to be of most benefit to the men of the future. What is the training required? I reply by saying that I know nothing better for this end than a wide and liberal training in the scientific spirit and the scientific method. The technicalities of science are not the first object; and, so far as they are introduced, it is only as media through which we may imbue the mind with certain general and abstract ideas. If called upon to define the scientific spirit, I should say that it was the love of truth for its own sake. This definition carries with it the idea of a love of exactitude, — the more exact we are, the nearer we are to the truth. It carries with it a certain independence of authority; because, although an adherence to authoritative propositions taught us by our ancestors, and which we regard as true, may, in a certain sense, be

regarded as a love of truth, yet it ought rather to be called a love of these propositions, irrespective of their truth. The lover of truth is ready to reject every previous opinion the moment he sees reason to doubt its exactness. This particular direction of the love of truth will lead its possessor to pursue truth in every direction, and especially to investigate those problems of society where the greatest additions to knowledge may be hoped for.

Scientific method we may define as simply generalized common sense. I believe it was described by Clifford as organized common sense. It differs from the method adopted by the man of business, to decide upon the best method of conducting his affairs, only in being founded on a more refined analysis of the conditions of the problem. Its necessity arises from the fact, that, when men apply their powers of reason and judgment to problems above those of every-day life, they are prone to loose that sobriety of judgment and that grasp upon the conditions of the case which they show in the conduct of their own private affairs. Business offers us an example of the most effectual elimination of the unfit and of 'the survival of the fittest.' The man who acts upon false theories loses his money, drops out of society, and is no longer a factor in the result. But there is no such method of elimination when the interests of society at large are considered. The ignorant theorizer and speculator can continue writing long after his theories have been proved groundless, and, in any case, the question whether he is right or wrong is only one of opinion.

I ask leave to introduce an illustration of the possibilities of scientific method in the direction alluded to. Looking at the present state of knowledge, of the laws of wealth and prosperity of communities, we see a great resemblance to the scientific ideas entertained by mankind at large many centuries ago. There is the same lack of precise ideas, the same countless differences of opinion, the same mass of meaningless speculation, and the same ignorance of how to analyze the problem before us in the two cases. Two or three centuries ago the modern method of investigating nature was illustrated by Galileo, generalized by Bacon, and perfected by Newton and his contemporaries. A few fundamental ideas gained, a vast load of useless rubbish thrown away, and a little knowledge how to go to work acquired, have put a new face upon society. Look at such questions as those of the tariff and currency. It is impossible not to feel the need of some revolution of the same kind which shall lead to certain knowledge of the subject. The enormous difference of opinion which prevails shows that certain knowledge is not reached by the majority, if it is by any. We find no fundamental principles on which there is a general agreement. From what point must we view the problem in order to see our way to its solution?

I reply, from the scientific stand-point. All such political questions as those of the tariff and the currency are, in their nature, scientific questions. They are not matters of sentiment or feeling, which can be decided by popular vote, but questions of fact, as effected by the mutual action and interaction of a complicated series of causes. The only way to get at the truth is to analyze these causes into their component elements, and see in what manner each acts by itself, and how that action is modified by the presence of the others: in other words, we must do what Galileo and Newton did to arrive at the truths of nature. With this object in view, whatever our views of culture, we may let science, scientific method, and the scientific spirit, be the fundamental object in every scheme of a liberal education.

S. NEWCOMB.

ECCENTRIC FIGURES FROM SOUTHERN MOUNDS.

IN a recent publication,[1] I have described a number of relics from the mounds, that present many new and remarkable features. The most important of these were two engraved shell disks, the designs upon which presented very marked variations from the work usually attributed to the mound-builders. Tracings of these are given in figs. 1 and 2.

Both specimens were found associated with characteristic mound relics, and had undoubtedly been deposited with the dead by the builders of the mounds. The question of origin was left for settlement to the light of future discoveries; the only conclusion reached being, that, while the ornaments had a northern character, the designs engraved upon them were decidedly southern, that is to say, Mexican or Central-American. Recently some important additions have been made to this class of works, and a flood of light has been thrown upon the subject.

Explorations in Georgia, conducted by Dr. Thomas for the bureau of ethnology, have brought to light two more shell gorgets bearing engraved designs of human figures. Outlines of these are given in figs. 3 and 4.

[1] Proc. anthrop. soc. Washington, vol. ii.

In case there should be any question as to the place of these objects among true mound relics, I present the following facts furnished by Dr. Thomas from the observations of his assistant, Mr. Rogan. The mound from which

FIG. 1.—Shell gorget from a mound in Missouri.

they were obtained belongs to the celebrated Etowah group at Cartersville, Ga., and is the one marked 'C' in plate I. of Jones's 'Antiquities of the southern Indians.' The burials were in a layer of dark, rich loam, and all in well-constructed stone cysts of the usual shape. They were not all at the same depth, but were near the base of the mound, and in every case beneath undisturbed strata of loam, sand, and hard-beaten clay. One of the engraved shells and three copper plates, one of which is given in fig. 5, were found in one grave. They were deposited with a very large skeleton, which had been wrapped in cloth and matting.

FIG. 3.—Shell gorget from a mound in Georgia.

A comparison of this pair with the examples from Missouri and Tennessee develops many important points of resemblance. The designs are clearly the work of, or at least have their origin with, the same people, and that people in all probability a Mexican people. This result is, however, not satisfactory, and other evidence is demanded. This is fortunately at hand. From the same mound with the articles of shell a number of copper objects were obtained. These contain *repoussé* figures corresponding closely with those engraved on shell. They are made from thin, well-polished sheets of copper of uniform thickness, some of which are a foot in width and twen-

FIG. 2.—Shell gorget from a mound in Tennessee.

ty inches in length. The figures have been stamped in high relief, and the outlines and perforate areas cut with mechanical precision. One of these curious images is shown in outline in fig. 5.

These objects are much corroded, and bear evidence of age corresponding to that of the other relics with which they were buried.

Another is almost a duplicate of this, while two others represent eagles. Very similar to the latter is a copper eagle, made also of sheet-copper, obtained by Major Powell from a mound in Illinois. A tracing of this is given in fig. 6.

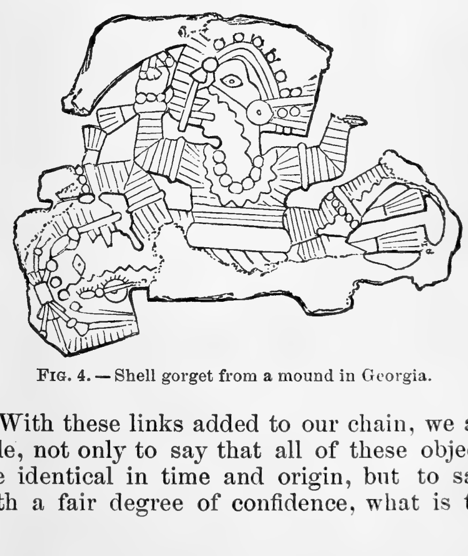


FIG. 4.—Shell gorget from a mound in Georgia.

With these links added to our chain, we are able, not only to say that all of these objects are identical in time and origin, but to say, with a fair degree of confidence, what is the

time and what the origin. The use of sheet-copper, manufactured and manipulated with mechanical precision, will to most minds be sufficient evidence of European agency and post-Columbian time.

This view is enforced by the presence of articles of brass and iron in the mound with one of the shell objects.

Besides this, a study of the designs themselves develops some interesting facts. Four of the designs presented, two on copper and two on shell, represent compound creatures, part bird and part man. This is a characteristic American conception, but in the execution of details there are features very suggestive of an oriental origin. The wings are, for instance, attached to the shoulder-blades behind, the arms being also present, and expand symmetrically to the right and left, resembling medieval angels more closely than Mexican deities. We notice, also, in the delineation of the eagle, a decidedly heraldic character, a symmetrical extension of the wings, legs, and talons highly suggestive of some imperial coat of arms.

In all their leading features the designs themselves are suggestive of Mexican or Central-American work; and, if actually derived from some of the highly cultured nations of the south, it is not impossible that this derivation was through aboriginal agencies: but some of the examples in shell and copper shown in the accompanying figures bear the ear-marks of transatlantic workmen; and I believe it quite probable that they are southern works copied in favorite American materials by the avaricious Spanish conquerors, and subsequently used in trade with all the tribes of the Gulf states. This is well known to have been a usual practice with our early traders.

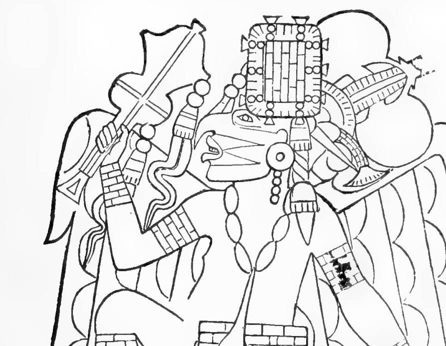


Fig. 5. — Copper image from a mound in Georgia.

Fig. 6. — Copper eagle from a mound in Illinois.

If in the end it should turn out that these remarkable objects are the unaided work of the mound-builders, we shall be compelled to recognize their standing in the manipulation of metal, and in the art of design generally, as unsurpassed by any other native American people. W. H. Holmes.

ADAPTABILITY OF THE PRAIRIES FOR ARTIFICIAL FORESTRY.

Various views have been entertained in relation to the treeless condition of the prairies of the interior region of the United States, some of which are rational, some partially so, and others positively erroneous. The opinion has been popularly held, that the prairies were originally covered with forests, as the region to the eastward of them was when it was first known to white men, and that from some unexplained cause these forests were destroyed. Those who entertain this view are disposed to discuss speculatively the origin of the prairies, and practically the means of reforesting them. These are views of men who lay no claim to scientific knowledge; but certain persons, even of scientific pretensions, have claimed that the character of the soil of the prairies is such,

that, although herbaceous plants may grow abundantly upon it, forest-trees cannot thrive. Others, again, suppose that the absence of trees upon the prairies is due to climatic causes, and that the growth of trees upon them by artificial planting will therefore always be precarious or impracticable. A large number of men, with no theory to support, who have made their homes in the great prairie region, have demonstrated by actual experiment that forest-trees will grow thriftily and to full maturity upon its soil.

It is my present purpose to speak of this success, and of the indication which it gives that the great prairie region of the United States may be made to produce the wood for all the needed fuel of the inhabitants, and also for other economic uses. Before doing so, however, it is desirable to describe that region briefly, as it existed when it was first occupied by white men, and to indicate in a general way its limits and its relation to adjacent regions.

It is difficult to define the boundaries of the prairie region as it existed then: first, because it merged, on the one hand, into the woodland regions, and, on the other, into the great arid plains of the west; second, its original characteristic features have been so changed by cultivation, its occupancy by homesteads and villages, and by the increasing presence of trees of both natural growth and artificial planting, that one now rarely gets sight of typical prairies as they existed over so large a region only a few years ago.

In the middle and Gulf states there were originally numerous treeless areas, which were, properly speaking, prairies; but to these I do not now refer. It is sufficient for my present purpose to say that the states of Illinois and Iowa lie in the heart of the region I shall discuss, and that it also embraces large adjacent parts of Wisconsin, Minnesota, Dakota, Nebraska, Kansas, and Missouri.

Although this region occupies a central position upon the continent, its average elevation is not great, a part of it being less than five hundred feet above the level of the sea. The general surface has an approximately level aspect; but it is often undulatory, and sometimes cut by deep valleys. It is traversed by two great rivers, the Mississippi and Missouri, and also by many of their tributaries. The valleys of these streams are cut down somewhat abruptly from the general level, to depths varying from a dozen feet to two or three hundred feet. The streams are bordered by level 'bottom-lands,' varying in breadth from a few rods to several miles.

These bottom-lands and the adjacent valley-sides, together with the contiguous ravine-broken land, contained all, or nearly all, the forest-trees which grew in that great region when white men first knew it; and even these surfaces were then largely destitute of trees. All the broad intervening spaces were covered with a dense growth of grass, mingled only with other herbaceous plants. So small was the aggregate of the timbered as compared with the grass-covered surfaces, that, from a long and early acquaintance with it, I estimate the former to have been not more than five per cent of the whole. In many parts of the region it was certainly less than this.

The early settlers found the Indians in the habit of burning the prairies annually; and they seemed to have practised that habit from time, to them, immemorial. The grass of this great region was largely burnt off every year, either by accident or design; so that from October until May the settlers were seldom out of sight of the lurid light of the burning grass by night, or the towering volumes of smoke by day. The next spring brought an equally abundant growth of grass from the unharmed roots, to fall, in turn, a prey to the devouring flames.

Although that condition of things prevailed within the memory of thousands of persons now living, the present prevalence of artificial groves, and the rapid natural encroachment of trees upon the before treeless surfaces, which followed the discontinuance of the annual fires, have nearly destroyed all the distinguishing characteristics of a prairie region. So rapidly is this change now taking place, that the next generation of those who are to occupy it will probably know of its original prairie character only from tradition or history.

The prairie region in question lies almost wholly within that over which the great northern drift is distributed; and its soil and subsoil are largely made up of the drift material, together with the silt deposit to which the name of 'loess' is now generally applied by geologists. The soil is therefore quite uniform in character over large portions of the region, and yet there is a good degree of variation in different localities. It is generally a rich, deep, dark loam, often without a stone or pebble in sight for many miles. But sometimes drift pebbles and bowlders are scattered plentifully upon the surface; and, in the valley-sides, escarpments of the underlying stratified rocks often appear.

To the westward of the Missouri River the prairies pass gradually into the great plains; and these continue westward to the base of the

Rocky Mountains. The general surface of the plains is similar to that of the prairies; and the character of the soil is also similar, except that it has not been so completely leached of its soluble salts, which are known by the popular name of 'alkali.' There is, in fact, no line of demarkation between the prairies and plains except a climatic one, and there is no other reason for giving them each a different designation than that which has resulted from climatic causes; that is, westward from the Missouri River there is such a gradual diminution of the annual rainfall, that in western Kansas and Nebraska it is insufficient for the purposes of agriculture, while in the eastern part of those states respectively it is ample. In a general way, the line between the arid and humid regions may be said to pass northward medially through the two states just named, swerving somewhat to the westward as it passes through Dakota Territory to the British line.

The trees which grew originally within the great prairie region were, with few exceptions, of the same kinds that grew in the wooded regions to the eastward of it; the more important of the missing kinds being the beech, chestnut, tulip-tree, and the common locust-tree. The more common kinds of trees which grew there were oaks (four kinds), hickory (three kinds), maple (two kinds), elm, cottonwood, black walnut, and linden. Among those which were less common were ash, honey-locust, sycamore, white walnut, mulberry, hackberry, Kentucky coffee-bean, and pecan. Besides these, a few pines and cedars grew upon the rocky cliffs of the valley-sides, and a few other trees were also scattered through the region; but the conifers, as compared with angiospermous trees were rare and of little importance. I use here only the common names of the trees, as given in Gray's 'Manual of botany.'

Traversing the prairie region from east to west and from south to north, it has been found that certain of the kinds of trees above named did not grow so far westward and northward, respectively, as others did. As regards the northern limitation of some, it was probably due mainly to temperature, and the western limitation of others was perhaps due, in part, to approaching aridity; but I think that to about the 98th meridian it was due to the only partially accomplished natural distribution of forest-trees from the eastward, which began at the close of the second glacial epoch. The first of the suggested causes of limitation has an important bearing upon the proper selection of trees for artificial planting in the northern portion of the prairie region. For example: while we may regard the oaks, maples, elm, cottonwood, linden, and others as practically without northern limit in the region under discussion, there are others, but fortunately they are mostly of less comparative value, which have their northern limit within this region. Among the latter may be mentioned the mulberry, honey-locust, Kentucky coffee-bean, and pecan. The hickories and black walnut were plentiful in the immediate region of the Mississippi and eastward, when the country was first known; and those trees seem to be the natural associates of the oaks.

Now, there are two general physical conditions which are inimical to forest-growth; and, wherever either of them is fully established, forests cannot exist. One of these conditions is an arctic climate, whether produced by high latitude or high elevation above the sea; and the other is an arid climate, or one where the annual rainfall is insufficient for the purposes of agriculture. I hold, that, in all regions of the earth which are not affected by either of these great climatic conditions, the foresting and reforesting of the surface, which is covered by a soil suitable for vegetable growth, is practicable for certain kinds of trees.

Neither of these conditions exists within the great prairie region as I have indicated its boundaries. It should therefore be expected that forest-trees would grow there, even if no experimental proof of the fact had ever been made. As one goes westward from this region, however, he finds the country incapable of supporting a growth of forest-trees for the same reason that it will not support a farm-crop; namely, because of its aridity. Both trees and farm-crops can and do grow successfully upon the prairies, because they have sufficient moisture from rainfall. Also, if one should go northward far enough, he would, of course, come to a limit of the successful growth of trees, and also to a limit to the growth of any farm-crop; but that limit is far beyond the northern boundary of the region here discussed.

The experiments of the dwellers upon the prairies have demonstrated that not only may all the indigenous trees of the adjacent valleys be made to grow on all varieties of its soil, but also that many kinds of eastern and exotic forest-trees, as well as most of the common fruit-trees, will grow there equally well. They have shown that the owner of any productive farm in that great region need not be deterred from planting any of those trees upon it, from any other consideration than he would give to the planting of a farm-crop.

These experiments show that certain kinds

of trees grow from artificial planting much more readily and rapidly than others, the cottonwood exceeding all others in these respects. Next, perhaps, comes the common locust, which, however, was not indigenous within the prairie region; but the cultivation of this valuable tree, which was formerly practised there with great success, was suspended, some twenty years ago, in consequence of the ravages of the 'borer.' Then follow certain trees which I name in the order of the apparent readiness and rapidity of their growth; namely, white maple, elm, black walnut, linden, oaks, and hickories.

The greater readiness and rapidity with which some of the trees named will grow by artificial planting do not imply that they have any greater vitality or permanence after their growth is established than the others: it only implies that they have greater promptness of vitality in establishing their growth. For example: the cottonwood may be grown with almost equal facility from the seed or from cuttings; but the oaks, hickories, and walnuts can be successfully grown in practical forestry only from the seed. Even the transplanting of these trees is not usually successful, but their cultivation from the seed is easy and natural.

While these facts concern the practical cultivator especially, they also have an important bearing upon the question of the original distribution of forests. The experiments referred to also show that not only will certain of the indigenous trees of the prairie region, which preferably grew upon the moist soil of the river-valleys, grow thriftily upon the upland prairie-soil, but that all kinds of the indigenous trees, as well as many others, will also grow thriftily upon all varieties of that soil. It is true that some of the soils — those of the loess of the Mississippi valley, for example — were more ready than others to receive tree-growth by the natural process of distribution; but this does not alter the fact, that all varieties of prairie-soil will receive and support an abundant forest-growth, when easily available artificial conditions are applied, and controllable unfavorable conditions are removed.

I have so far spoken of the facility with which trees will grow upon prairie-soil by artificial planting. I have now to speak of another phase of the subject of the propagation of forest-trees; namely, that of their natural encroachment upon prairie surfaces.

The borders of the primitive prairies, where woodland and prairie joined, were usually occupied by thickets of hazel and other shrubs, mingled with stunted trees. Also, for considerable distances out upon the grassy surface, there were numerous dwarfed stubs of oaks, hickories, and other trees, sometimes putting out small branches, only to be destroyed in a year or two by the fires; sometimes burnt to the ground, but their roots remaining alive, and sending up vigorous shoots next year, only to be burnt off by the next fire which should sweep across the adjacent prairie. The prairie borders were thus kept stationary year after year by the fires. It was a perpetual contest between vigorous and progressive vegetable life and its deadly enemy, with material conquests upon neither side.

As soon as the annual fires were stopped by the increasing inhabitants, which they did as a necessary provision for safety, the natural encroachment of the forests upon the prairie borders went on so vigorously, that it required the preventive means of agricultural occupancy to check it.

There are now many thousands of acres of land in the great prairie region, which are densely covered with a full variety of mature forest-trees, which were parts of grass-covered prairie borders when the country was first settled. In many cases, cultivated farms, which were originally established upon the open prairie borders, are now surrounded by woodland, which has become such by natural means since the fires were prevented. Doubtless, local conditions have varied the rate of encroachment of forest-trees upon the prairie borders; but it is plain that the natural tendency is, and always has been, in that direction. This tendency is, in fact, the leading element in original forest distribution, — a process, which, in the present case, beginning with the close of the second glacial epoch, probably progressed mainly from the eastward and south-eastward. This process of distribution was only partially accomplished in the prairie region when it was first known to white men. No doubt, the uncompleted state of the distribution was primarily due to the want of necessary time for its accomplishment since the distribution began; but it was certainly long held in check by the annual prairie fires.

It is not my present purpose to discuss geological questions with regard to the prairies; but since the remains of trees, which have not unfrequently been exhumed from beneath the surface in that region, have been supposed to afford proof of the former forested condition of the prairies, it is desirable to refer briefly to that subject. It is no doubt true, that the great prairie region was formerly occupied by a forest-

growth, as many other now treeless parts of North America have been, not excepting at least a large part of the present arid region; but those forests existed in other geological epochs, and they have been destroyed by subsequent unfavorable physical changes. The region of the great prairies has also been shorn of its forests once, and perhaps twice, since the tertiary period: that is, in the tertiary period, and even before, an extensive arboreal flora prevailed in North America, which was closely related to that which now exists; but, with the accession of the glacial epoch, the forests of the region here discussed were necessarily wholly destroyed, except, perhaps, along its southern borders.

Accumulating evidence seems to show, that there was an interglacial epoch of temperate climate, during which that great region was again covered with forests, and that these were in turn destroyed by the second glacial epoch. It is the remains of these interglacial forests that have been so frequently found in excavations made in the prairie region, and which have excited so much local interest. Those forests were evidently extensive; but, unlike those now living there, they seem to have consisted largely of conifers. I do not doubt, that, at the close of the second glacial epoch, the present prairie region of the United States was as completely destitute of trees as any of its present prairies were when white men first discovered them. The opinion also seems a reasonable one, that the foresting of the prairies has been slowly in progress, ever since the close of the second glacial epoch, by the process of natural dispersion, and, furthermore, that this dispersion of trees progressed mainly from the south-eastward. Not only were the interglacial forests necessarily destroyed by the icy visitation of the second glacial epoch, but the whole, or nearly the whole, surface was rewrought, and practically a new soil was produced by the glacial action and the subsequent physical conditions.

Such a new soil would naturally be first occupied by herbaceous plants, whose abundant and annually matured seeds are so readily distributed by natural means. So, also, the pioneer occupants of the new land among the trees would doubtless be those whose light and abundant seeds are capable of being distributed by the winds, and whose most congenial habitat is upon the moist grounds which border the streams: such are the cottonwood, willows, and elm, for example. It is especially the first two that are found to be the most advanced of the western arboreal pioneers upon the borders of the great plains, and which were doubtless the pioneers in the primitive foresting of the prairie region. Other trees followed those pioneers more slowly, for their methods of propagation were slower; but still the methods of natural propagation of the majority are sufficiently vigorous to suggest, that, if the prairie fires had never been introduced, the early settlers would have found that great region a forested instead of a prairie one.

How long the battle of the fires against the trees continued is not known; and by what successive steps the latter succeeded in gaining and holding even the small strips of land along the borders of the streams of so wide a region, hundreds of miles from the place of their original departure, it is difficult to say. It is probable that the pioneer trees effected their occupancy there, to a large extent, before the fires prevailed, and that their presence favorably modified the immediate conditions for the occupancy of other trees. The streams also seem to have favored their occupancy, not only by the additional moisture which they gave to the adjacent soil, but by acting as checks to the fires which alternately swept the prairies on each hand, lessening the average frequency of fires upon their bordering bottom-lands by perhaps one-half of what it otherwise would have been.

The subject, as I have attempted to present it, may be summed up briefly as follows: in the natural geographical distribution of faunas and floras, nature necessarily fixes the potential boundary of such distribution at a greater or less distance in advance of the boundary of actual occupancy; and, when these two boundaries come to coincide, there is necessarily an end to distribution. When the prairie region was first known, the potential boundary-line of forest occupation was at least five hundred miles westward from that of full occupancy.

At the close of the glacial epoch the whole of the great prairie region was practically destitute of vegetation, but its new soil was capable of supporting an abundant and varied growth. Herbaceous vegetation first occupied the soil, and trees followed more slowly. The obstacles to the occupancy of the new soil by forest-trees at the close of the glacial epoch were, first, the slowness of the process of natural distribution; second, the pre-occupancy of the soil by herbaceous vegetation, preventing or retarding the effective germination of the seeds of trees; third, the subsequent prevalence of annual fires upon the grassy surfaces, which retarded forest-growth.

The conditions favorable to the natural dis-

tribution of trees in that region were a fruitful and congenial soil and a favorable climate. If the fires had never been introduced, the two first-named obstacles to forest-distribution in the prairie region would probably have been practically overcome by the time when the country was first settled; but, upon their introduction, an equilibrium of the retarding and accelerating forces was established and long continued. With the final cessation of the fires, and with the favoring conditions incident to agricultural occupancy, that equilibrium was destroyed, and the vigorous natural tendency to forest-distribution again asserted itself. It is now in full force except where it is checked by human agency; and it is greatly accelerated where such agency is exerted in its favor. It therefore only remains for the inhabitants of the great prairie region to decide whether their land shall be forested or treeless.

C. A. WHITE.

THE APPLICATION OF PHOTOGRAPHY TO THE PRODUCTION OF NATURAL HISTORY FIGURES.[1]

FROM the accuracy and rapidity of its delineations, photography has proved itself an invaluable aid to science, although in natural history its use has been somewhat limited from the difficulty or impossibility of putting many of the objects in a vertical position. To make photography applicable to all classes of objects, it is simply necessary to have the camera so arranged that it may be placed at any angle from horizontal to vertical. The object to be photographed may then occupy its natural position, whatever that may be. For the last ten years, there has been in constant use, in the anatomical department of Cornell university, an apparatus constructed on this principle. It consists essentially of a camera fastened to a board that may be swung from horizontal to vertical, and clamped firmly at any angle.

With this instrument have been photographed, not only objects ordinarily photographed with a vertical or horizontal camera, but delicate embryo brains and other objects that would collapse if removed from liquid. Living salamanders (Necturi) have been photographed under water, their gills remaining completely outspread.

[1] Papers on this subject were given by the writer at the meeting of the American association for the advancement of science in 1879, and at the meeting of the Society of naturalists of the eastern United States in 1883. The only other persons employing a vertical camera in photography, known to the writer, are Dr. Theo. Deecke of the State lunatic-asylum at Utica, N.Y., and Dr. Dannadieu of Lyons, France. (For the last, see Anthony's *Photographic bulletin*, December, 1883, p. 404.)

A photograph answers the requirements of a scientific figure in but few cases; as the object usually is to bring out with diagrammatic clearness a few details, subordinating or omitting others: hence the photograph is used as the basis of the figure; that is, the object is delineated of the desired size, all the parts being in their proper relative position. From this photographic picture may be traced all the outlines directly upon the drawing-paper; thus avoiding the tedious labor of measurement by

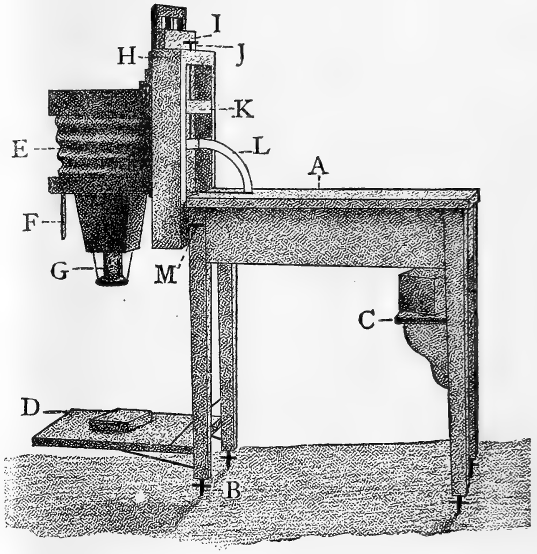


FIG. 1. — Side view of a vertical camera. *A*, the table supporting the camera; *B*, levelling-screws; *C*, shelf for holding a box of sand as counterpoise; *D*, stage upon which the object is placed (it is made parallel with the top of the table); *E*, camera with cone; *F*, slotted brass guide (see fig. 2); *G*, the photographic objective (its cap is made of card-board, and covered with black velveteen; it is held in position by two rubber bands); *H*, frame hinged to the table, and supporting the camera; *I*, movable board to which the camera is clamped; *J*, head of the focusing-screw; *K*, block fastened to the movable board *I*, and containing the nut which receives the focusing-screw; *L*, semicircle by which the frame bearing the camera is set at any angle; *M*, thumb-screw pressing against the semicircle *L*, and serving to fix it at any point.

the artist, and leaving all of his time available for artistic work proper.

While, however, the use of the photograph for outlines diminishes the labor of the artist about one-half, it increases that of the preparator; and herein lies one of its chief merits. The photographs being exact images of the preparations, the tendency will be to make them with greater care and delicacy, and the result will be less imagination and more reality in published scientific figures; and the objects prepared with such care will be preserved for future reference.

In the use of photography for figures, several considerations arise: 1°. The avoidance of distortion; 2°. The adjustment of the camera to

obtain an image of the desired size and focusing; 3°. Lighting and centring the object; 4°. The obtaining of outlines for tracing upon the drawing-paper.

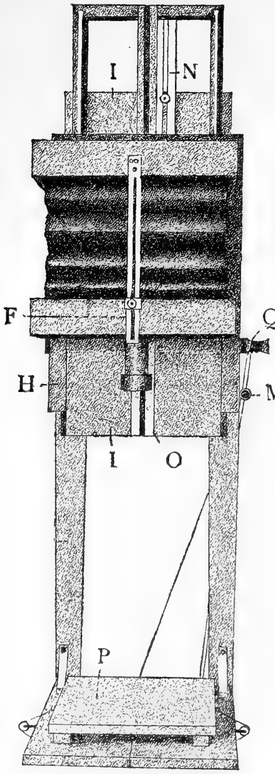


FIG. 2.—Front view of the vertical camera. *F*, slotted brass guide, serving to support the upper part of the camera, and to indicate the enlargement or reduction; *H*, frame hinged to the table; *I*, board moving in the frame *H*, and holding the camera; *N*, iron bars attached to the bed of the camera (upon these presses the thumb-screw from the board *I*); *O*, similar iron bars in the movable board (in the slot works a thumb-screw from the camera; these thumb-screws clamp the camera to the movable board); *P*, object-carrier on casters (this may be moved by the operator by turning the spools *Q*); *Q*, spools for the cords from the object-carrier.

1°. While the camera delineates rapidly, the image is liable to distortion. I believe opticians are agreed, that, in order to obtain correct photographic images, the objective must be properly made, and the plane of the object must be parallel to the plane of the ground glass. Furthermore, as most of the objects in natural history have not plain surfaces, but are situated in several planes at different levels, there will be a liability of distortion from that cause also. This may be rendered practically nothing, however, by using in the objective a diaphragm with a small opening.

2°. By placing the camera on a long table, and a scale of some kind against the wall, the exact position of the ground glass for various sizes may be determined once for all. These positions are noted in some way (on the brass guide, *F*, in the apparatus here figured). Whenever it is desired to photograph an object, natural size, for example, the ground glass is fixed in the proper position indicated on the brass guide (fig. 2, *F*). Then, as the relative position of the objective and the ground glass cannot be varied, it is necessary, in focusing, to move the camera toward or away from the object, or the reverse. In order to do this, the camera is fastened to a board which moves in a frame by means of a screw (figs. 1, 2, *I*, *H*, *J*). Whenever the camera is to be moved considerably,—as to a position for twice natural size from one giving an image of half natural size,—the position of the camera on the board is changed by loosening the two thumb-screws clamping it to the movable board (fig. 2, *N*, *O*). The approximate position for the various sizes being once determined and noted, it is but a moment's work to set the camera for any enlargement or reduction within its range.

3°. The object is placed on the horizontal stage, and so arranged that the lighting will give prominence to the parts to be especially emphasized. For a contrasting background, black velveteen for light, and white paper for dark, objects, have been found excellent. To get the object in the centre of the field of the objective, the stage bearing the object may be movable; so that the operator, while looking at the image on the ground glass, may move the object in any desired direction by turning the spools on which are wound the cords from the movable stage (fig. 2).

4°. If the photographic prints are to be used solely for outlines, the well-known blue prints so much used in engineering and architecture may be made. If, however, light and shade and fine details are to be brought out with great distinctness, either a silver or a platinotype print is preferable. In whatever way the print is made, it is blacked on the back with soft lead-pencil, put over the drawing-paper, and the outlines traced. Instead of making a print from the negative, one may get a tracing directly from it on tracing-paper; and this may, of course, be used in the usual way. Finally, if one possesses a camera, a tracing may be made of the image directly, without the aid of a negative. It is only necessary to substitute a piece of plain glass for the ground glass, and, after spreading upon it some fine tracing-paper, to trace the image. This is especially applicable to the enlargement or reduction of other figures.

SIMON H. GAGE.

THE COLORS OF NATURAL WATERS.

Mr. W. Spring, of the University of Liege, has greatly advanced our knowledge of this subject in a paper in the *Revue scientifique* for Feb. 10, 1883, a translation of which also appeared in the *Popular science monthly* for May. He begins with a careful and critical summary of the views of previous observers, and from these and his own experiments reaches the following important conclusions: 1. Water, in the purest state in which it can be obtained, has a distinct and beautiful blue color, which must be regarded as its essential or proper color, as the color of absolutely pure water; 2. The green, yellow, and brown colors observed in water are due to the reflection of light by matter held in suspension. This suspended foreign matter is very finely divided, and probably is usually in the state of nascent precipitation. It may be liquid or solid, transparent or opaque.

"The important point is, that it be competent to reflect light. Then the light-rays of feebler intensity (violet, blue, green, etc.) suffer extinction, one after another, according to the thickness of the medium, till the yellow rays, the brightest to our eyes, are the last to survive the struggle.

"The obstruction of the light, inducing the yellowish tint, which may be produced by any salt, depends less on the quantity of the salt present than on its being near the stage of precipitation. Small quantities of a feebly soluble salt produce the same effect as large quantities of a more soluble salt. The variety in the colors of natural waters, then, may be thus explained: absolutely pure water, viewed in masses of sufficient thickness, has a beautiful blue color. If it holds in complete solution colorless salts, its color is not changed; but, in proportion as it may contain matter on the verge of precipitation, the light traversing it will be of a yellow or darker color, until a stage is reached when the liquid will let no light through, and becomes opaque or black. The yellow light will combine with the blue light of the water; and thus will be produced greenish-blue, bluish-green, and green tints, according to the strength of the yellow. If the latter is very strong, the dark blue will be wholly smothered, and the water will appear yellow, brown, or of a still darker color."

The less soluble bodies in natural waters — those which may be regarded as frequently in the state of nascent precipitation, and to which the colors are chiefly due — are the carbonates of calcium, and silica, and also, probably, the finest mechanical sediment or clay, which, although not properly soluble, forms an emulsion with water, and affects the light in the same way as an incipient precipitate.

This theory appears to me to be the only one yet advanced affording a consistent explanation of all the phenomena; and my present purpose is to call attention to a general and important fact concerning the color of natural waters (which appears to have been but little noticed or appreciated by scientific observers, and of which I have never seen any explanation), and to show that it harmonizes beautifully with Mr. Spring's theory. Briefly stated, this general fact is as follows: tropical and warm seas are blue, and polar and cold seas are green; i.e., other things being equal, the color of the water is determined by the temperature.

All voyagers in tropical seas must have noticed the magnificent blue color of the water; the color seeming to be purest and most intense under the equator, or where the water is warmest. On passing to higher latitudes and lower temperatures, the color changes to greenish blue, bluish green; and green, although the Gulf Stream and other warm currents carry the tropical color and temperature well up toward the frigid zones, and into the midst of seas whose prevailing tint is deep green. Probably nothing makes the Gulf Stream seem more real, especially to the unscientific observer, than the great contrast in color that is presented within a very short distance, when we cross its northern wall. On one side is the cold, green water of the polar current, and on the other the warm, blue water of the Stream. The difference in color between the Gulf Stream and the surrounding parts of the ocean is noticeable even in the North Atlantic, on the track of the transatlantic steamers; and I have found that this part of the sea is perceptibly greener in winter than in summer.

As already stated, this general difference in color between warm and cold seas, although not explained by Mr. Spring, is a necessary corollary of his theory: for warm water is, for most substances, a more powerful solvent than cold water; and if cold seas are green in consequence of some of the contained salts being imperfectly dissolved, i.e., in a state of nascent precipitation, then an increase of temperature in the water, by augmenting its solvent power, will tend to obliterate the green color, and restore the blue. Again: warm water possesses less adhesion than cold water, which would cause a more rapid deposition of fine clayey matter in warm water than in cold. Hence, if the green color of cold seas is due, not to imperfectly dissolved salts, but to the suspension of fine insoluble clays, forming an emulsion, an increase of the temperature of the water, by causing a more complete deposition of the suspended clayey matter, will also tend to change the color of the water from green to blue.

In short, it follows from this theory, that, other things being equal, the color of natural waters must be a function of the temperature; and this conclusion is sustained by observation. One general exception, however, should be noted; viz., that shallow water near shore is usually green, even in warm seas, on account of the large amount of foreign matter in suspension. This was very noticeable on the coast of Cuba; the sea being of a pure blue color to within a few rods of the beach, and then rapidly changing to green. When viewing the coast from an elevated promontory, these colors were quite distinct to the eye for a distance of one to two miles along the shore.

As affording additional confirmation of the theory, I offer the following notes on the colors of European waters, which were made during the summer of 1883, while travelling from Sicily to Throndhjem in Norway. I was not able to make corresponding observations of the temperature of the water; but this may be approximately inferred, in most cases, from the latitude and season.

April 14 to 16. — The Mediterranean, between Stromboli and Sicily, is a decided blue, but not so deep and brilliant as the blue of the Gulf Stream and West-Indian waters. In the harbors of Messina and Catania the water is a brilliant green, inclining to blue. The color of the sea along the entire east coast of Sicily, from Messina to Syracuse, as viewed from the land, is blue, inclining to green.

April 22 to 26. — The water about the Lipari Islands, and between them and Messina, is of a dark, intense blue.

April 27. — The Bay of Naples is dark green, with scarcely a trace of blue.

April 28. — The sea about Salerno, and between that and Amalfi, as seen from the shore, is a beautiful blue-green, but sometimes pure bright green, and again, when deep, inclining strongly to blue.

May 1. — The Bay of Naples, between Naples and Ischia, is a deep green, without a trace of blue.

May 4. — The sea all about Capri and Sorrento is a pure, deep, and beautiful blue. These shores are vertical walls of rock, which afford very little sediment to the water. Later in the summer, as many observers testify, the Bay of Naples is blue throughout.

June 1 to 4. — The waters of the Italian lakes — Como, Lugano, and Maggiore — are a beautiful and distinct green. John Ball, F.R.S., in his 'Alpine guide,' states that the southern end of Lake Maggiore is blue. I found it almost as green as the northern end: but it is probably blue in mid-summer; and, if so, it must be regarded as a striking confirmation of the theory.

June and July. — The Swiss lakes are generally bright green and somewhat opaque. Lake Geneva, however, as is well known, is a lovely blue, resembling the sea about Sicily; but toward the upper end it seemed to be slightly greenish. The other Swiss lakes derive their waters from regions that are largely composed of limestone, and hence these waters are saturated with carbonate of calcium. But the Rhone, which is the principal tributary of Lake Geneva, drains a region of metamorphic rocks containing but little limestone.

Aug. 2. — The Baltic, between Stralsund and Copenhagen, is dull green.

Aug. 3 to 4. — The color of the Cattegat is dull green, without a trace of blue.

Aug. 7 to 23. — Between Christiansand and Throndhjem the open sea and the lower parts of the fiords have a deep, dark green color, with scarcely ever a suspicion of blue. As we ascend the fiords, the color becomes a lighter green, and more vivid and opaque, in proportion as the water becomes fresher. The heads of the fiords and the adjacent lakes are usually indistinguishable in color from the Swiss lakes; but the beautiful Ringedalsvand, lying between the head of the Hardanger Fiord and the celebrated Ringedalsfos, at an altitude of fifteen hundred feet, is a notable exception. This lake is deep blue except near the shore, where it is greenish blue; and the streams flowing into it, as well as that flowing out, are nearly pure blue. The rule that cold water is green does not hold in this case, but the exception is readily explained as due to the unusual purity of the water. The lake is bounded on all sides by cliffs of granitoid gneiss, and where there is a talus at the bottom it is usually destitute of soil. Above the cliffs are immense fields of snow, whence the water of the lake is derived. None of the tributary streams flow from glaciers; but they are all limpid snow-water flowing down over hard rocks, which are alike destitute of soil or material which could be carried away in suspension in the water, and of limestone or other materials capable of being dissolved in the water. It would probably be difficult to find any considerable body of natural water which is more nearly a pure distilled water than this. And we may fairly say, that, on account of its remarkable purity, it is blue, in spite of its low temperature.

W. O. CROSBY.

THE GEODETIC WORK OF THE HAYDEN AND WHEELER SURVEYS.

THE publication of the final results of the triangulation of these surveys furnishes the material for a direct comparison between them, inasmuch as the two surveys covered in duplicate large areas of country. Fully one-half the mountain area of Colorado, and a large extent of country in north-eastern Utah and south-eastern Idaho, have thus been surveyed in duplicate. An examination shows, that in the former area no fewer than twelve points have been occupied in common as geodetic stations, and their positions published by each organization. The following are the points in question, with the latitudes and longitudes as given by each survey, the determinations of the Hayden survey preceding in each case. The names in parentheses are those given to the points by the Wheeler survey.

STATIONS.	Latitude.	Longitude.
Blanca	37° 34′ 43″.5	105° 28′ 55″.4
	37 34 37 .0	105 28 57 .0
Pagosa	37 26 43 .1	107 3 47 .2
	37 26 37 .0	107 3 50 .0
Rio Grande Pyramid (Simpson)	37 40 52 .2	107 23 19 .2
	37 40 46 .0	107 23 22 .0
Uncompahgre	38 4 23 .0	107 27 30 .1
	38 4 18 .0	107 27 33 .0
Ouray (Hunts)	38 25 26 .1	106 13 15 .7
	38 25 20 .0	106 13 18 .0
Agency Knob	38 16 30 .7	106 51 47 .6
	38 16 24 .0	106 51 54 .0
Wilson (Glacier)	37 50 26 .4	107 59 16 .9
	37 50 21 .0	107 59 20 .0
Leon	39 4 51 .0	107 50 24 .7
	39 4 45 .0	107 50 27 .0
South River (Macomb)	37 34 31 .7	106 58 40 .2
	37 34 25 .0	106 58 43 .0
Summit (Meigs)	37 21 7 .3	106 41 35 .4
	37 21 1 .0	106 41 39 .0
Sneffels (Blaine)	38 0 19 .0	107 47 18 .7
	38 0 14 .0	107 47 22 .0
Banded	37 6 21 .6	106 37 24 .5
	37 6 16 .0	106 37 27 .0

The following are the discrepancies between the above results:—

STATIONS.	DISCREPANCIES.	
	Latitude.	Longitude.
Blanca	6″.5	1″.6
Pagosa	6 .1	2 .8
Rio Grande Pyramid	6 .2	2 .8
Uncompahgre	5 .0	2 .9
Ouray	6 .1	2 .3
Agency Knob	6 .7	6 .4
Wilson	5 .4	3 .1
Leon	6 .0	2 .3
South River	6 .7	2 .8
Summit	6 .3	3 .6
Sneffels	5 .0	3 .3
Banded	5 .6	2 .5

It will be seen that the discrepancies in latitude are quite constant, ranging from 5″.0 to 6″.7, the Hayden latitudes being in every case the greater; and that the discrepancies in longitude are almost equally constant, ranging, with the exception of one case, from 1″.6 to 3″.6, the Hayden longitudes being in every case the smaller. The comparatively large discrepancy in the longitude of Agency Knob is explainable by the fact, that, from most points of view, this station presents an ill-defined summit. The constancy of these discrepancies points to the fact, that they are in the main due to station-error, as is unquestionably the case. The Hayden work was based on Denver as determined astronomically by the U. S. coast and geodetic survey, while the Wheeler work depends upon Colorado Springs as determined by the Wheeler survey. The relative station-error of these two places has not been determined directly, but cannot fail to be considerable, owing to the difference in their surroundings.

Assuming that the difference in station-error between Denver and Colorado Springs is, roughly speaking, equal to the average difference between the Hayden and Wheeler work (leaving out Agency Knob), — i.e., 5″.9 in latitude, and 2″.7 in longitude, — and correcting one of the two above sets of results therefor, the discrepancies between them become as follows: —

STATIONS.	DISCREPANCIES.	
	Latitude.	Longitude.
Blanca	0″.6	1″.1
Pagosa	0 .2	0 .1
Rio Grande Pyramid	0 .3	0 .1
Uncompahgre	0 .9	0 .2
Ouray	0 .2	0 .4
Agency Knob	0 .8	3 .7
Wilson	0 .5	0 .4
Leon	0 .1	0 .4
South River	0 .8	0 .1
Summit	0 .4	0 .9
Sneffels	0 .9	0 .6
Banded	0 .3	0 .2

The mean of these differences in latitude is but 0″.55, and in longitude, with the exception of Agency Knob, but 0″.41.

The area surveyed in duplicate north of the Union Pacific railroad in north-eastern Utah and south-eastern Idaho does not show quite so close accordance in results. The Hayden work here depends upon the astronomical determination of Salt Lake City by the U. S. coast and geodetic survey, and is checked upon the determination of Ogden by Wheeler's survey, upon which the Wheeler work rests. This check shows little or no difference in station-error between the two astronomical stations. The following are the positions of five points

occupied in common by the two surveys, as given by Hayden and Wheeler, the determinations of the former preceding: —

STATIONS.	Latitude.	Longitude.
Putnam, Idaho	42° 57′ 10″.6	112° 10′ 9″.4
	42 58 8 .0	112 10 10 .0
Preuss (Meade), Idaho	42 29 42 .6	111 15 11 .0
	42 29 41 .0	111 15 11 .0
Soda (Sherman), Idaho	42 27 53 .7	111 33 11 .4
	42 27 52 .0	111 33 11 .0
Caribou (Pisgah), Idaho	43 5 36 .2	111 18 56 .7
	43 5 34 .0	111 18 58 .0
Willard (North Ogden), Utah	41 21 44 .9	111 57 53 .1
	41 21 45 .0	111 57 53 .0

The following are the differences between the two sets of results: —

STATIONS.	DIFFERENCES.	
	Latitude.	Longitude.
Putnam	2″.6	0″.6
Preuss	1 .6	0 .0
Soda	1 .7	0 .4
Caribou	2 .2	1 .3
Willard	0 .1	0 .1

The average differences are respectively 1″.6 and 0″.5.

It is to be regretted that the distances between these points, as determined by the Wheeler survey, are not available, in order that a more direct comparison might be made.

It should be understood that the object of each of these systems of triangulation was simply and solely to furnish adequate control for topographic work, to be published on a scale of four miles to an inch, or about $\frac{1}{250000}$. A greater degree of accuracy than was required for this purpose was not contemplated. In all cases natural points were used as signals until the stations were occupied, when rude cairns of stone, six to eight feet in height, were erected, and used thereafter as signals. The Hayden work was carried on with an eight-inch theodolite, reading to 10″; and the work was adjusted by a graphic method, with foresights only. The area triangulated by this survey aggregated nearly a hundred and twenty thousand square miles; which work, besides the measurement and expansion of four base-lines, was done by one party in six field-seasons, each of four months' duration. As a rule, all the work upon a station was completed in a few hours. The general character of the Wheeler work was very similar to that of the Hayden survey, except that the adjustments were made by least squares.

HENRY GANNETT.

THE DEEP-SEA DREDGING APPARATUS OF THE TALISMAN.[1]

THE first French deep-sea exploring expedition was made in 1880 by the Travailleur, in the Bay of Biscay. The following year the Travailleur was again put at the disposal of the commission over which Mr. Milne-Edwards presided; and the party traversed the Bay of Biscay, visited the coast of Portugal, passed the Strait of Gibraltar, and explored a large part of the Mediterranean. In 1882 the same vessel undertook a third expedition into the Atlantic Ocean, and proceeded as far as the Canary Islands. But the Travailleur, being a despatch-boat for harbor use, did not possess the requirements for making long voyages; and accordingly the Talisman, a cruiser, was equipped for a new dredging expedition, and left the port of Rochefort on the 1st of June, 1883, with Mr. Milne-Edwards and the commission appointed by the minister of public instruction on board. The Talisman explored the coasts of Portugal and Morocco, visited the Canaries and Cape Verde, traversed the Sargasso

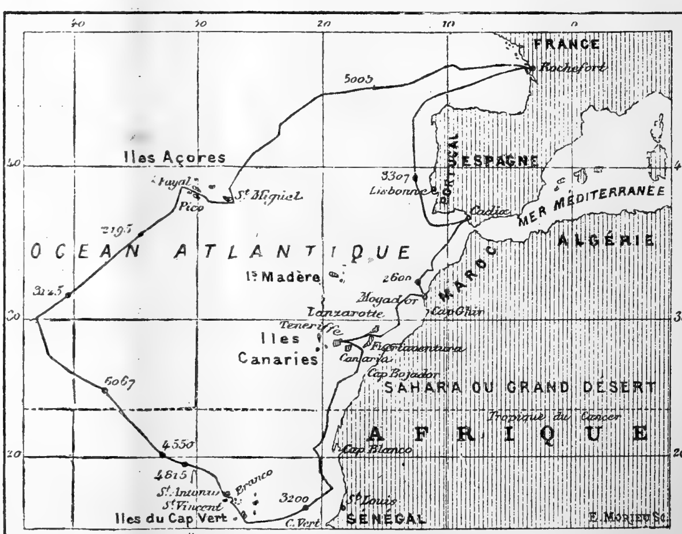


FIG. 1. — Course of the Talisman.

Sea, and, after remaining some time at the Azores, returned and explored the Bay of Biscay (fig. 1).

On the bridge of the Talisman there had been

[1] Condensed from an account in *La Nature*. By H. FILHOL.

arranged a sounding-machine, worked by engines, and the electric-light apparatus. From the foremast

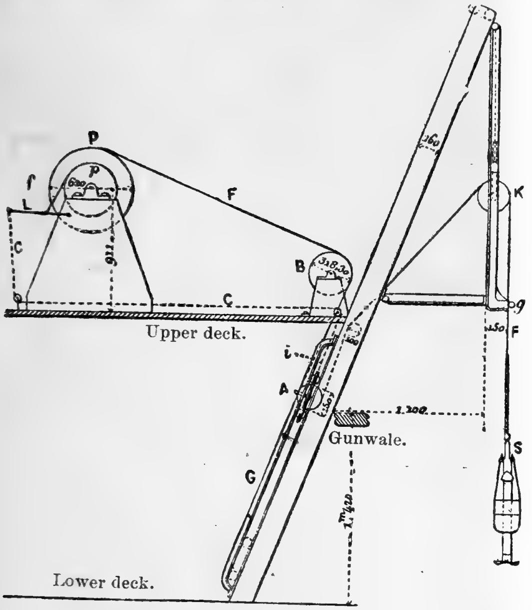


FIG. 2.— Plan of the sounding-apparatus.

a beam or crane projects beyond the vessel to carry the dredges or trawls. The sounding-apparatus used was devised by Mr. Thibaudier, and automatically registers the number] of metres of cable run out, and stops when the sounding-cup reaches the bottom. Fig. 3 represents a part of this apparatus, and fig. 2 the plan of another part, in order the better to show its action. It is composed of a reel (*P*, fig. 2) on which were rolled ten thousand metres of steel wire one millimetre in diameter. From the reel the wire passes round a wheel, *B*, exactly one metre in circumference: from there it runs down to a wooden slide, *A*, moving along the sheers, mounts to a fixed block, *K*, and reaches the sounding-cup *S* after having crossed a guide, *g*. The wheel *B* carries at its axis an endless screw, which sets in motion two toothed wheels, showing the number of turns made. One registers the units, the other the hundreds (fig. 4). The latter is graduated to measure ten thousand metres. Each turn of the wheel *B* corresponds to one metre, the number indicated by the register representing the depth. On the axis of the reel there is a brake. Another brake, *f* (fig. 2), is worked by a lever, *L*, at the extremity of which there is a cord, *C*, which is fastened to the slide *A*. When the vessel rolls, and the tension of the steel wire supporting the sounding-cup increases or diminishes, the slide is slightly lowered or raised along the sheers: in this movement it acts more or less on the brake, and consequently regulates the rapidity of unrolling. When the sounding-cup touches the bottom, the running-out of the wire, suddenly relieved of its weights (which sometimes amount to seventy kilograms), instantly stops.

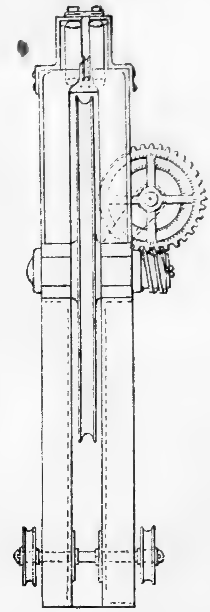


FIG. 4.—Register of sounding-line paid out.

The action of this apparatus is easily understood. The sounding-cup and its weights are arranged within the ship. Some one is stationed at the lever *L* (fig. 2). The register is put at zero. Every thing being thus arranged, the brake is freed, and the unrolling continues until the bottom is reached. While sounding, the vessel is kept motionless by means of its engine, that the wire may remain as vertical as possible. When the bottom is reached, one has only to read the indication on the register to know the depth. Connected with the axis of the drum is a little engine to raise the sounding-cup when relieved of its weights.

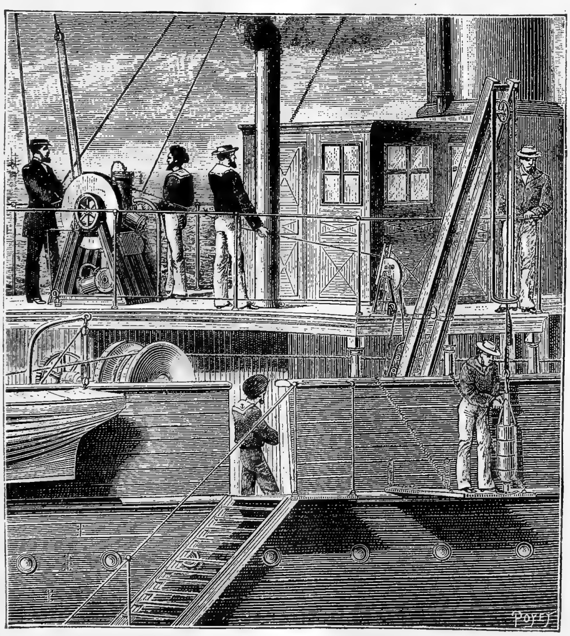


FIG. 3.— General view of the sounding apparatus.

The sounding-cup (fig. 5) consists of a long and stout iron tube having two chambers, placed one on the other, and perfectly independent of each other. In the upper compartment there is a metallic rod,

at the upper end of which is a ring, and to this is attached the sounding-line. When this is pulled, the rod moves up slightly, a stop controlling its course at a certain point. On the opposite sides of this rod are hooks. To accelerate the descent of the sounder, it is loaded with large cast-iron disks. On the outer surface of these disks are two longitudinal grooves through which pass wires from a ring under the lowest disk, ending in two rings resting on hooks just below the upper end of the sounding-rod. When the lead reaches the bottom, and the pull on the sounding-wire ceases, the rod to which the wire is attached falls in the upper compartment of the sounding-tube, releasing the rings from the hooks, and allowing the iron disks to slide off. Relieved of the extra weight, the lead is easily raised. The lower end of the tube is supplied with valves, which are closed by the falling of the iron disks, and enclose any loose matter on the bottom, the action being assisted by a coating of tallow.

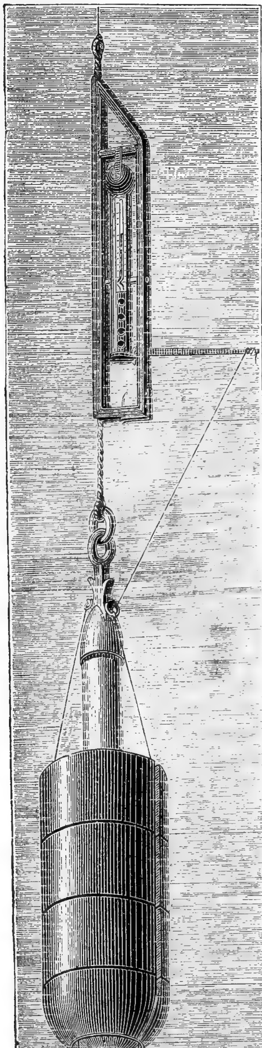


Fig. 5. — Sounding-cup and thermometer.

The thermometers used to determine the temperature of the water at great depths often have to sustain a pressure greater than three hundred atmospheres; that is, more than thirty tons to a square decimetre. Two are used, incased in very thick glass walls. When the lead reaches the bottom, and the extra weights become detached, the catch holding the thermometer-case is released by the breaking of the cord attached to the long lever shown in the upper part of fig. 5, and the thermometers are inverted. The mercury-column is then broken at a point above the bulb where the tube is narrow, and the mercury in the tube falls to the lower end, which is graduated.

On the Travailleur a hemp rope was used for the dredges, of which we give a cut showing its actual size (fig. 8, no. 1), which was not only cumbersome, but had little strength, breaking under a load heavier than two thousand kilograms. On the Talisman a wire rope (fig. 8, no. 2) was employed, composed of six strands of seven steel wires each, twisted around a hempen core. Notwithstanding that it was formed of forty-two wires, its diameter was only one centimetre. Upon trial it bore a weight of forty-five hundred kilograms without breaking.

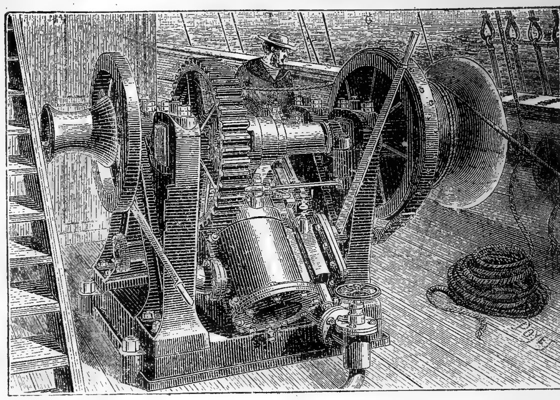


Fig. 6. — Windlass for raising the dredges and trawls.

The collecting-apparatus used on board the Talisman consisted of dredges and trawls. The dredges have an iron frame of rectangular shape, to which is fitted a sack formed of closely-woven cords. The sides of the frame, before reaching the bottom, stand up at right angles, and are provided with scrapers cut and inserted at such an angle that they not only detach clinging objects, but gather the very smallest specimens on the bottom. In speaking of the dredge of Dr. Ball, which for more than ten years (1838–48)

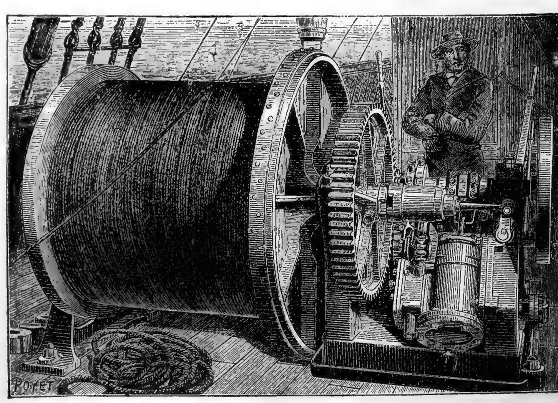


Fig. 7. — Reel for wire rope.

has been in the employ of the English, Wyville Thomson said, that he one day saw the inventor scattering on the floor pieces of money, and raising them again with the greatest ease by means of the

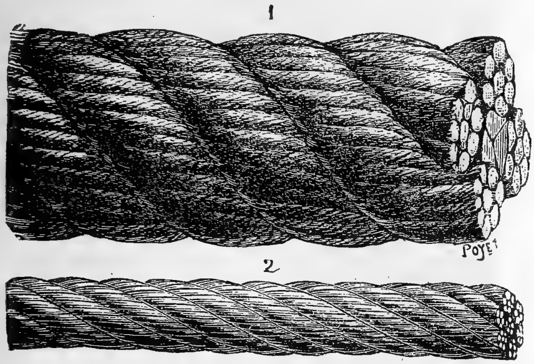


FIG. 8.—Old (1) and new (2) dredging-lines, natural size.

instrument he had contrived. This shows the important use of the teeth with which the sides of the frame are furnished.

To protect the net, which would be torn to shreds by the rocks as it is drawn along, it is enclosed either in another net of iron links, or in a sail-cloth or leather bag. Its lower end acts as a kind of clog, being so arranged that objects, once having entered, cannot escape. The front part of the dredge is sometimes furnished with a rake, to turn the mud or sand of the bottom, and thus to liberate the animals found there. During the explorations of the Travailleur, dredges were sometimes used which, by a special mechanism, descend, closed, to the bottom, and open only when they reach it. But, whatever the plan of the dredge, the results are not valuable; for these machines are almost immediately filled with sand or mud, which, on account of the sail-cloth or leather bag, cannot be released. Generally, when a dredge is raised, a sackful of sediment is all that is brought on board. They are, besides, very inconvenient.

During one of the cruises of the Porcupine, Wyville Thomson noticed, that, while the interior of the dredge enclosed very few interesting specimens, a number of echinoderms, corals, and sponges, caught on the outside of the sack, and sometimes even on the upper part of the chain of the dredge, came to the surface. "This suggested," said he, "many expedients; and finally Capt. Calver sent down half a dozen of the 'swabs' used for washing the decks, attached to the dredge. The result was marvellous. The tangled hemp brought up every thing rough and movable which came in its way, and swept the bottom as it might have swept the deck. Capt. Calver's invention initated a new era in deep-sea dredging." It is certain that the use of tangles gives good results; but they, too, are very inconvenient, as Wyville Thomson was forced to acknowledge.

"The tangles," he says, some pages beyond the passage quoted above, "certainly make a sad mess of the specimens; and the first feeling is one of woe, as we undertake the almost hopeless task of clipping out with a pair of short nail-scissors the mangled remains of sea-pens, the legs of rare crabs, and the dismembered disks and separated arms of delicate crinoids and ophiurids. We must console ourselves with the comparatively few things which come up entire, sticking to the outer fibres, and with the reflection, that, had we not used this somewhat ruthless means of capture, the mutilated specimens would have remained unknown to us at the bottom of the sea." The description is exact; but one must examine the condition of the larger part of the specimens brought up by the tangles, to understand the despair of the naturalists in their search among inextricable confusion of threads, and remains of rare, often unknown, animals. We thus see the necessity of some better method of collecting and bringing up the animals.

During the campaign with the Blake, in the Gulf of Mexico, Mr. Agassiz used trawls, a kind of large net common on our coasts among fishermen, and obtained good results. On board the Talisman, trawls of the same kind, with an opening two or three metres in extent, were employed. The dredges are very rarely used, these being reserved for the exploration of rocky bottoms, where the sharp edges would cut the net into pieces. In fig. 10 is shown one of the trawls used on the Talisman. By an examination of this cut, one can understand the arrangement of the net, which is such, that, on whatever side the machine reaches the bottom, it is always drawn to some purpose. There are two pockets, one inside the other. At the end of the outer one a large cast-iron ball is tied, while the inner pocket opens at its lower end, preventing objects which have entered from getting free again. During the course of the cruise, Commandant Parfait had one of the tangles

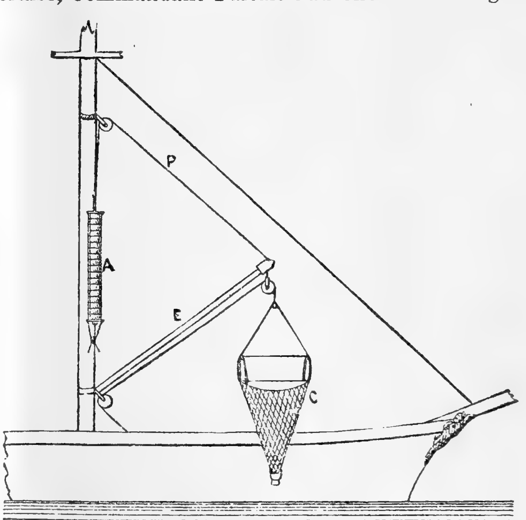


FIG. 9.—Action of the 'accumulator.'

placed at the very bottom of the trawl, with remarkable results. The success was due to the fact that a crowd of all the little animals, crustaceans, mollusks, and ophiurans, which, drawn in with the water into

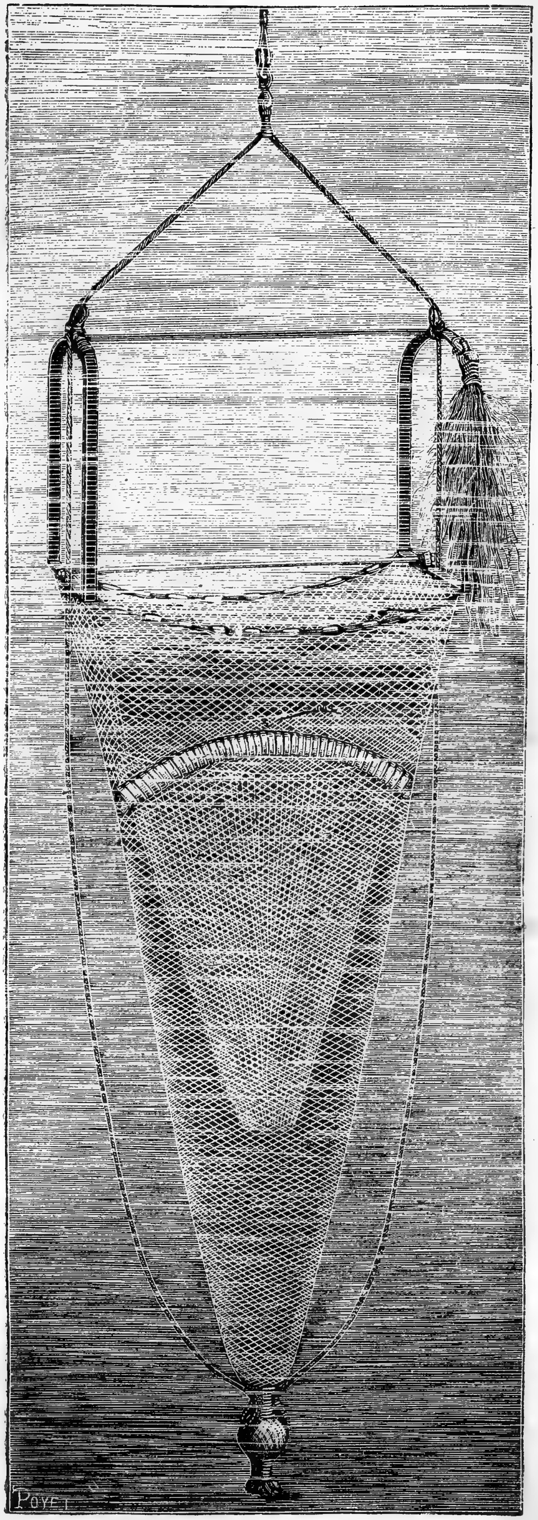


FIG. 10.—The trawl.

the interior of the trawl, would have passed through the meshes of the net, were caught by the long threads of the tangles.

That the strain on the drag-line may be eased, a wire rope (*P*, fig. 9) is made fast to the end of the beam, and, after passing over a block, is connected with a spring balance or 'accumulator,' *A*, made of disks of rubber, and attached to the mast.

The size of the trawl used depends upon the depth to be reached and upon the weather. As a general rule, it may be said that in good weather a trawl of three metres length is used to explore a depth of thirty-six hundred metres. Beyond this depth, a three-metre trawl cannot be used. Lower than three thousand metres, the additional burden is a hundred and eighty-eight kilograms.

When every thing is ready for the lowering of the trawl, the machines are freed, and at first the net is allowed to fall by its own weight and that of the cable which holds it; but after a little time the rapidity becomes too great, and must be regulated by the brakes. During the descent, the ship is held with the wind at the stern, or at least on the side, with its fore and mizen sail set. It must have a speed of at least two knots; and if with the wind alone it cannot make so much, its rate must be increased by steaming. Commandant Parfait discovered that this speed of two or three knots was absolutely necessary, if the cable were to be always taut. If this tension was not maintained, the cable descended more quickly than the trawl, rolled itself up on the bottom, and the net dropped on the bundle thus formed. In this case the cable became tangled, and kinks were formed in great numbers throughout its length. A register on the windlass (fig. 6), around which the cable passes before running into the water, indicates the moment when the net should reach the bottom. When this is reached, the full force of the brakes is applied, and the cable firmly held in place.

To insure the drawing of the trawl along the bottom, it is necessary to unroll a length of the cable greater than the depth of the sea. To a depth of six hundred metres, twice the length is paid out: deeper than this, five or six hundred metres more than sufficient to reach the bottom are run off. While the trawl is dragging, the ship is kept in such a position that it slowly drifts sideways. The time during which the trawl is left on the bottom varies greatly with the depth. In deep dredging it is dragged three-quarters of an hour, at times even several hours. When the trawl rises from the water, it is drawn upon the deck, and placed as seen in fig. 11. In order to obtain the animals enclosed in the thick, sticky mire often brought up in the trawl, the latter must be sifted very carefully. For this purpose a set of metallic frames, placed one upon the other, and raised on balls, is used. By simply giving these frames a backward and forward motion while water is showered into the mud, the smallest animals are obtained without receiving any injury. We have endeavored to show this operation in fig. 11.

Besides the sounding and dredging apparatus,

there were, on the Talisman, special instruments for obtaining water at various depths. It is very important to know the composition of the water in which a certain fauna lives, in what proportion (sometimes under great pressure) gases are dissolved in it, and how much salt it contains. This kind of examination had already engaged the attention of the naturalists on the Challenger and on the Blake. During the cruise in 1882, made by the Travailleur in the Bay of Biscay, on the coasts of Spain and Portugal, and in the Mediterranean, water was drawn from very great depths. For this purpose, water-bottles, consisting of strong metal tubes with valves at both ends to allow of a free circulation, were attached to a sounding-line at distances of five hundred metres apart. The valves were kept open by means of brass levers extending out from the line. When a proper length of line had been run out, a ring was slipped over the line, and allowed to descend, knocking the levers and closing the valves as it went down. With each bottle was attached a self-registering thermometer. The gases contained in the water tend very energetically to escape, pressing strongly on the valves, and closing the mouths more effectively. It has often happened, that, upon opening the valves, a jet of water was thrown from the bottle, like Seltzer.

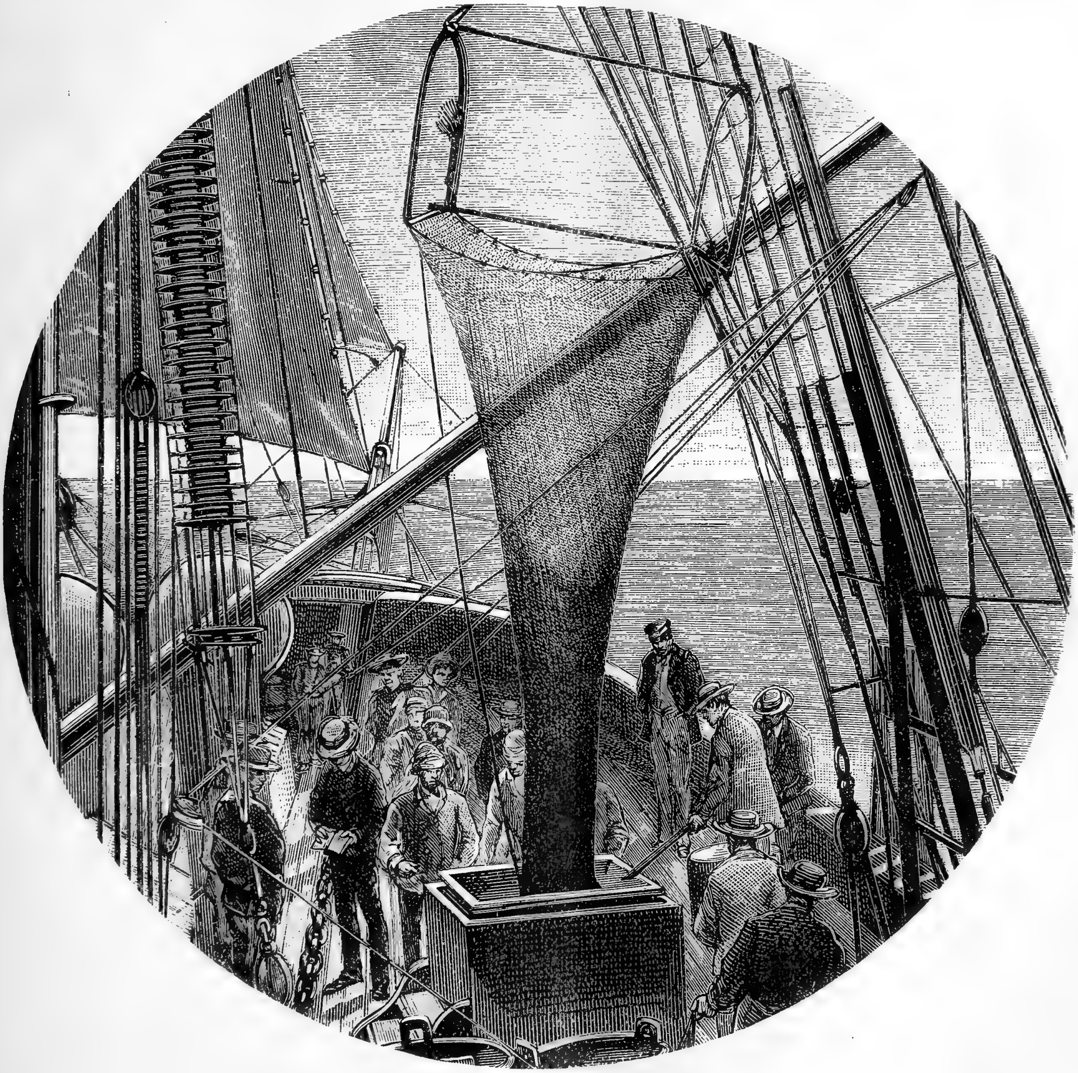


FIG. 11.—Examining the contents of a trawl.

The sampling of water from great depths is, as has been shown, a process which requires considerable time. Accordingly an attempt was made, on board the Talisman, to simplify the work when water was desired, not for the gases which it contained, but in order to investigate the germs which it held. The fol-

lowing plan was adopted. Thick glass tubes, narrowed at the ends, and closed by an enamelling-lamp after a vacuum had been previously formed, were attached to the metallic tube enclosing the thermometers. They were arranged in such a manner, that, when the overthrow of the latter took place, one of their slender ends struck the lower part of the metallic frame bearing the thermometer. Under this shock the point struck broke, and then the water rushed into the interior of the tubes, from which it could not make its escape on account of the small diameter of the entrance. At each sounding, therefore, a specimen of the water at the bottom was brought up; and it was very easy to preserve this by immediately sealing the tube.

Dredging at great depths requires considerable time, so that it often happens that the trawl can be brought on board only very late in the day. In the tropics night comes on early, the twilight in these regions being of short duration. To overcome this important difficulty, care was taken, while equipping the Talisman, to arrange electric apparatus capable of furnishing light so bright, that, when the trawl was raised during the night, it was possible to search with great care for the smallest objects brought up. For this purpose, a Gramme machine was placed upon the bridge, and was connected with a set of Edison lamps, lighting either the trawl or the interior of the laboratory. The lamps on the bridge were supplied with a reflector, allowing a bright light to be thrown upon the sea. Thus the approach of the trawl to the surface could be easily watched.

The Edison lamps used to light the ship were also useful, by floating in the water, in attracting fishes into the nets previously arranged. One can imagine the beauty of the scene when these brilliant lights are lowered into the water. The surrounding sea is illuminated with dazzling and constantly changing rays. It seems as if one were watching beautiful medusae, which, like bright disks, rise and fall with the waves, turn and disappear, to rise again a few minutes later more sparkling than ever.

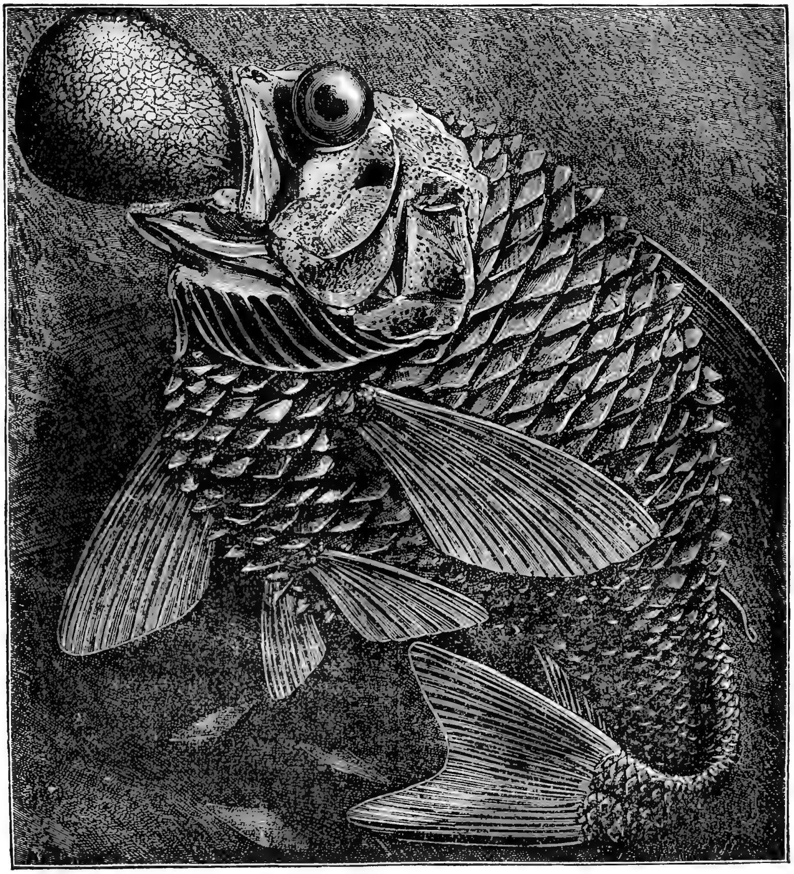


FIG. 12.—Effect of expansion on the air-bladder of a fish taken from a depth of fifteen hundred metres.

Contrary to expectation, the deep-sea fish brought to the surface are somewhat affected by the expansion they have experienced. Many fishes possess a peculiar organ, consisting of a closed sac situated

above the intestine, against the spinal column. The presence of this air-bladder allows a fish to rise and sink with great ease. In the case of a fish taken at a great depth, and brought to the surface, the gases enclosed in this bladder expand to a very considerable extent. As a result, the bladder presses upon the abdominal wall, and, as this expands, it gradually loses by abrasion the scales which cover it. When the expansive limit of the bladder is reached, its lower end pushes against the stomach, on the head of which it rests, enters the mouth, and leaps outside. The pressure which is thus brought to bear on the upper wall of the mouth-cavity is so great that it yields, and the eyes are forced from the sockets. We have endeavored, in fig. 12, from a specimen in the exhibition of the Talisman, to show in what state fishes caught at a great depth are brought to the surface. The same enormous pressure, brought to bear upon the collecting implements, may be understood

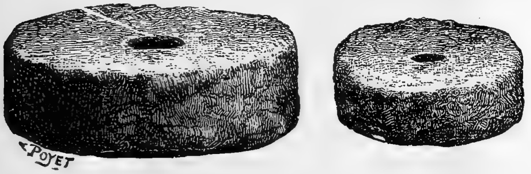


Fig. 13.—Effect of deep-sea pressure on cork.

from the injury to one of their parts. In order to keep the mouth of the trawl-net open, there is arranged within a set of large cork disks strung on a string. These disks, when new, have a rather large diameter, but after a few days' use they shrink to about half their original size. Under the pressure exercised, the tissue of which they are made settles considerably, and at the same time becomes as hard as wood. Fig. 13 shows different sides of two of the disks,—one before use, the other after,—drawn upon the same scale.

THE USE OF NAPHTHALINE AS AN INSECTICIDE.[1]

Naphthaline, in one form or another, has for some time been used by entomologists as a means of preventing injury to their collections from Acari, Psoci, Dermestes, Anthreni, and other museum pests. My own experience is, that it destroys the Acari and Psoci, but not the other pests, though it tends to repel them. Recent investigations would seem to indicate that it may be used to advantage in the field as an underground insecticide. It appears that as early as 1842 a French physician, Rossignon, pointed out the possible use of naphthaline, not only as a remedial agency in medical practice, but also as a substitute for camphor, for the destruction of museum pests. But up to the appearance of the grape Phylloxera in France, no serious experiments were made with it in the field. Among the substances tried against this pest, naphthaline played its part. The efficient ingredient in the 'poudre insectivore' of Peyrat, was, according to Maurice Girard, naphthaline; but the experiments with it did not yield encouraging results.

Baudet recommended it to the French academy in 1872; while in 1874 E. Fallières proposed gypsum saturated with naphthaline, the mixture to be distributed over the soil. It was also among the numerous substances experimented with by Messrs. Maxime Cornu and P. Mouillefert, the results of which were published in the well-known memoir presented by these gentlemen to the French academy in 1877. Naphthaline, up to this time, proved to be of little value in killing the insect, and of no value as a repellant. Nevertheless, Dr. Ernst Fischer of the Strassburg university, encouraged and induced by the most favorable results obtained with naphthaline as an antiseptic and as a destroyer of micro-organisms (moulds, Schizomycetès, Bacteria, etc.), has, since 1881, again experimented with it as a direct remedy for the Phylloxera; and he has given us the results of his experience in an interesting brochure lately received. The first part of Dr. Fischer's work treats of, and strongly recommends, the use of naphthaline for surgical purposes as an antiseptic superior, in most respects, to all other antiseptics now in use. His conclusions are based on extensive experiments showing the effect of the material on the lower organisms, and prove, that, properly used, it not only arrests the growth of these micro-organisms, but eventually destroys them. This part of the work will be of especial interest to those who are experimenting with a view of destroying disease-germs. It is to the second part that I would here call attention. Preliminary to a statement of the results of this part of Dr. Fischer's work, a few facts in regard to the nature of the substance may not be out of place.

Naphthaline, a carbohydrate of the formula $C_{10}H_8$, was first made in 1820, by Garden, from coal-tar. It is volatile at any temperature, melts at 79.2° C., boils at about 214° C., and has a specific gravity of about 1.1. Essentially insoluble in water, alkalies, and diluted acids, it is easily soluble in ether, hot alcohol, hot concentrated sulphuric acid, and in many volatile and rich oils. It is readily carried off with aqueous vapors; so that, in order to quickly disinfect a room, it is only necessary to heat a vessel with water in which naphthaline has been put. The naphthaline gas mixes very readily with atmospheric air, and is also readily taken up by water. It is not poisonous to man or to the higher animals, and, for surgical purposes, should be used chemically pure. The crude material is by far cheaper; and, upon inquiry, Dr. Fischer found that in London it can be obtained, without barrels, at 25 marks ($6) per 1,000 kilograms (about 2,200 pounds), in Paris at 100 francs, and in Cologne at about 45 marks (barrels included). The crude naphthaline contains more or less phenol and creosote, and is a stronger insecticide than the purified article, but also more injurious to plants. Dr. Fischer used the purified naphthaline in his experiments on Phylloxera, but thinks that with some pre-

[1] Das naphtalin in der heilkunde und in der landwirthschaft. Von Dr. Med. Ernst Fischer. Strassburg, *Trübner*, 1883.

caution the crude material might safely be used, especially if it is not brought in direct contact with the plant, or if used in the dormant season.

The experiments with phylloxerized grape-vines were carried on under direction of Dr. Fischer at La Grave d'Ambarès, near Bordeaux. Fifteen badly infested stocks,[1] partly growing on light, partly on heavy soil, were treated in April, 1883.

It was placed in a hole dug in the ground near the main root, and subsequently covered up; and the quantity used was on some plants one, and on others one-half, kilogram. On Sept. 18 the plants were examined, with the following result: all plants experimented with, but especially those treated with the largest quantity of naphthaline, showed a new and healthy growth of numerous long, fine rootlets, which were perfectly free from Phylloxera: in fact, the Phylloxera had entirely disappeared from the roots of all plants experimented with, whereas several plants not treated with naphthaline showed no young growth of rootlets, and an abundance of Phylloxera. The growth above ground, of the plants treated, showed no difference as compared with plants not treated, — a fact explained by insufficient time for the treated plants to recuperate. Some of the most vigorous new rootlets were found to have penetrated the layer of naphthaline, thus showing that the latter has no injurious influence upon them. A considerable quantity of the naphthaline was found unchanged at the date of examination, which shows that the evaporation is very slow, and that its effects will be correspondingly lasting.

The results are certified to by official affidavits, and were more marked on plants growing in heavier and moister ground than on those in light and gravelly soil.

As the most convenient mode of application, Dr. Fischer recommends that about one kilogram of the naphthaline be put in a trench dug around the plant a few inches from the stock; the trench to be not less than from fifteen to twenty centimetres deep, and to be at once filled up again. He attributes the failure of former experiments, 1, to the small quantity of the material employed; 2, to its being employed too near the surface of the ground, so as to permit evaporation in the air. He also thinks that results were expected after too short a lapse of time. C. V. RILEY.

RECENT DETERMINATIONS OF STELLAR PARALLAX.

DR. DAVID GILL, director of the Cape observatory, has presented to the Royal astronomical society of London the results of the heliometer determinations of stellar parallax made by him and Dr. W. L. Elkin. The distances of each star, the parallax of which was sought from two comparison-stars situated on opposite sides of it, were measured at the times when the effect of parallax was least and when it was greatest.

[1] It is not stated whether the roots of these stocks were examined at the time, to ascertain whether or not the Phylloxera was still at work.

The following were the results obtained for the stars observed: —

	Parallax.	Probable error.
α Centauri	+ 0″.75	± 0″.01
Sirius	+ 0.38	± 0.01
ϵ Indi	+ 0 22	± 0.03
Lacaille, 9,352	+ 0.28	± 0.02
o^2 Eridani	+ 0.166	± 0.018
β Centauri	− 0.018	± 0.019
ζ Toucani	+ 0.06	± 0.019
e Eridani	+ 0.14	± 0.020

The probable error of a single observation by Dr. Gill averaged 0″.1, and of a single observation of Dr Elkin, 0″.16. The determinations had all been made with the Cape heliometer of four inches aperture, and with a power of a hundred and seventy-five diameters.

Dr. Gill refers to the importance of parallax investigations in order that our knowledge of the sidereal system may be advanced. We do not know at present whether bright stars, or stars having large proper motions, are the more likely to give large parallaxes. There are, therefore, two questions to be solved, — first, what is the average parallax of stars of the first magnitude, of stars of the second magnitude, of the third, and so on? and, second, what connection is there between the parallaxes of the stars, and their proper motions? The present series of measures shows that the parallax of a star can be determined from sixteen measures with a probable error of ± 0″.02, assuming that the observations were free from systematic errors. With a more powerful instrument, which would give a greater choice of comparison-stars, it would seem that any systematic errors might be eliminated. There are sixteen stars of the first magnitude in the southern heavens: a similar number of stars might be selected of the second, sixteen more of the third, and so on. In making these observations, a reversing-prism should always be employed, as in the Cape measures, that the results may not be affected by the position of the comparison-stars. It should always be borne in mind that measures of two or more pairs of stars are much better than repeated measures of the same pair of comparison-stars. Another most necessary precaution is the use of screens to render the two stars equal in brightness. The heliometer employed should have a considerably greater light-gathering power than the Cape instrument, that there may be a freer choice of comparison-stars. It should be of at least seven inches aperture. A considerably higher power than the one used in the Cape determinations should also be employed. A single observer, by making two hundred or two hundred and fifty observations each year, might complete the entire series in the course of ten years. This is a work urgently demanded in the interest of sidereal astronomy, and one that should be undertaken without hesitation or delay.

The heliometer of the observatory of Yale college is yet more powerful and perfect than that of Dr.

Gill at the Cape observatory, and it is hoped that Dr. Elkin will employ it in continuing these remarkable measures. We believe that no method of determining stellar parallax, so accurate and expeditious as this, has ever before been at the command of astronomers.

Simon Newcomb.

CARNIVOROUS HABITS OF THE MUSKRAT.

At a recent meeting of the Biological society of Washington, a paper was read by Mr. Henry W. Elliott, setting forth an entirely new fact in regard to the diet of the common muskrat (Fiber zibethicus), proving that carp-ponds in the west are being completely devastated by this animal. Ponds which should produce many carp are almost entirely barren; and for a long time the owners have been unable to account for it, no hawks being seen, there being no possibility of escape from the ponds, and in some it being impossible for other people to take them with a seine on account of obstructions placed in the way to prevent this. It was finally suggested, and afterwards proved conclusively, that muskrats were the miscreants. Carp have the stupid habit of sticking their noses into the mud during the winter, and hibernating; thus rendering it possible for so clumsy an animal as a muskrat to obtain them easily, — a thing which it would probably do in winter, when roots, etc., its natural food, are hard to obtain. If it be a fact that the muskrat has acquired the habit of eating carp, immense damages are likely to result, unless speedy and extreme measures be taken; for, under these circumstances, such a sluggish and poorly protected fish as the carp can hardly be expected to resist or avoid its enemy, but will become its easy prey: and thus one of the most important works of the fish-commission, from which such great economic benefits were expected, will result in nothing. As a means of getting rid of these pests, so hard to shoot, and not easily trapped, poisoning by means of strychnine placed in apples was suggested as the best, it having been applied with success in many cases. In his communication, Mr. Elliott asserted that in no monograph of the animal could he find any mention of the diet of the muskrat, other than that it was an exclusive vegetarian, and, so far as he could ascertain, this was the first time that the carnivorous appetite had ever been brought before scientific men; in which statement he was sustained by an authority upon mammals, present at the meeting. This was surprising to many; for it seems to be well known, as was proved by the discussion which followed the paper, that the muskrat will, and does frequently, under favorable conditions, eat animal food. One gentleman mentioned that he had seen muskrats take bait, and even live fish, from his hook, while fishing in fresh water. The piles of Unio shells frequently seen upon the tops of muskrat mounds, also prove conclusively that it will at times eat animal food. It is noticed that the shells are always perfect, not even having chipped edges; and it would seem strange that this should be so, unless we supposed that they were left to die before being eaten, the meat then being easily picked out.

The muskrat is not the only rodent which departs occasionally from a vegetable diet; for such animals as the squirrel and capybara are, and have been for a long time, known to eat flesh when the circumstances are favorable. Mice and rats, of course, are well known to be omnivorous, eating animal food as quickly as vegetable, this being the partial result of contact with man. In the other orders of herbivorous mammals, examples of deviations from the normal class of food are frequent, especially under domestication: for example, the feeding of fish to cattle; while, under similar conditions, the carnivorous dog and cat can be made to eat vegetables or vegetable products. By thus adding one more animal to the number of recorded species which will adopt an opposite diet from the natural, Mr. Elliott is deserving of credit; for, notwithstanding the fact that it is known to some, still it has never been placed before the scientific world in any recognized monograph or treatise upon Rodentia.

Ralph S. Tarr.

CONDITIONS OF GROWTH OF THE WHEAT-RUST.

The last part of the journal of the Royal agricultural society of England has sixty pages devoted to a 'Report on wheat-mildew.' Mr. W. C. Little prepared an extended list of questions concerning the wheat-mildew, or wheat-rust (Puccinia graminis), to which a large number of answers were received from British farmers who had suffered from the rust. From these reports it is gathered, that the rust is more prevalent in those localities where the atmosphere is most moist. Spring frosts, heavy rainfalls, and violent changes of temperature, encourage rust. Hot weather, with frequent thunder-storms, is most favorable for the rapid development of the fungus parasite. Some of the observations point toward the belief that about eleven days are required for the full development of the Puccinia after it has entered the wheat-plant.

Perhaps the most valuable results of the compiled answers are those upon the relation of soils to the rust. The pest is more prevalent on peat and clay soils than on gravel or light lands. Drainage is a partial preventive of rust. High farming encourages the development of rust, especially if the wheat is rank, and it becomes lodged or fallen. There is an agreement of opinion that rust prevails in wheat sown after clover. Newly broken up lowland pastures are seldom sown to wheat because so sure to become rusted.

Dr. J. B. Lawes holds the view that plants are liable to the attacks of parasites, either insects or fungi, in proportion as the soil is deficient in available mineral food. Common tilled land contains about ninety-seven per cent of mineral matter, and three per cent of vegetable substance. The lowlands have this proportion nearly reversed. Dr. Lawes says, "Plants are very much like ourselves: their power to escape disease, and to struggle against

it when attacked, depends very much upon their state of health." Dr. Voelcker, the chemist of the Royal society, has said, "I believe the soil has a great deal to do with mildew. An excess of available nitrogenous food appears to me to have a decided tendency to cause mildew in wheat. A clover-crop leaves a large amount of nitrogenous matter in a soil, and renders wheat following it liable to attacks of rust." Dr. Voelcker further agrees with Dr. Lawes when he says, in answer to Mr. Little's letter, "A sudden check by cold or continued wet weather has a decided tendency to favor the attacks of mildew in wheat; and this tendency is greater in highly manured land than in poor soil, or, at all events, on land which is manured with too much nitrogenous food, or on land naturally rich in such food." Four widely different soils upon which wheat had been grown were analyzed by Dr. Voelcker, and it was found that the amount of mildew determined by extended observations varied directly with the per cent of nitrogenous matter in the soil. But much depends on previous cropping, and therefore the ratio between mildew and nitrogenous matter in the soil may vary to a limited extent.

The large amount of evidence gathered, and presented in extended tables, shows that some sorts are more capable than others of resisting rust, though no varieties are rust-proof. White wheats suffer more than red sorts. It is best to sow early maturing varieties, and sow them early.

Byron D. Halsted.

New York.

THE CODEX CORTESIANUS.

Codex Cortesianus, manuscrit hiératique des anciens indiens de l'Amérique Centrale conservé du Musée archaeologique de Madrid photographié et publié pour la première fois avec une introduction et une vocabulaire de l'écriture hiératique Yucateque. Par Léon de Rosny. Paris, *Maisonneuve*, 1883. 26 + 49 p., 42 pl. 4°.

This volume by Léon de Rosny is undoubtedly the most important contribution to Central-American paleography which has appeared since the publication of Landa's 'Relacion,' and the 'Manuscrit Troano' by Brasseur de Bourbourg. In it we have a photo-engraved reproduction of the recently found aboriginal manuscript known as the 'Codex Cortesianus,' thus adding one more to the brief list of pre-Columbian Maya documents which have so far been discovered. The name 'Cortesian' has been applied to it because of the supposition that it had once belonged to Hernando Cortez.

Up to 1876 but three of these manuscripts — the 'Dresden codex,' the 'Codex Troano,' and the 'Codex Peresianus' (or 'Manuscrit mexicain No. 2') — had been brought before the public. About this time a proposition was made to the Bibliothèque impériale of Paris by some one in Spain (the name is not given) to sell to it an ancient American manuscript. A photographic copy of two pages accompanied the proposition as specimens of the volume. On account of the high price demanded, the proposition was not accepted. Shortly afterwards it was obtained by the Spanish government, and deposited in the archeological museum at Madrid. One of these two pages was copied by Mr. Rosny in plate 11 of his "*Essai sur le déchiffrement de l'écriture hiératique de l'Amérique Centrale;*" and the other, which is beyond question a missing half of the initial page of the 'Codex Troano,' in plate 5 of his "*Documents écrits de l'antiquité américaine.*"

In 1880 Mr. Rosny went to Madrid expressly to see and study this codex, and, if possible, to obtain a copy of it. Through the kindness of Don Juan de Dios de la Rada, the curator of the museum; his mission was eminently successful, as he was permitted, not only to examine it, but to make two complete photographic copies of it. It was from these, I presume, that the plates of the present work were made.

We learn from the introduction, that the original, like the other three Maya manuscripts, is written on both sides of a strip (probably of Maguey paper) covered with a coat of white paint. Judging by the specimen given in Mr. Rosny's '*Essai sur le déchiffrement*,' plate 11, I presume the figures are partially colored, though not so highly nor to the same extent as in the Troano manuscript; but unfortunately this is not shown in the present work.

The general appearance, the figures, the form of the characters, and numerous other particulars, prove very clearly that it is more closely related to the Troano manuscript than to any other one of the Central-American codices. This is so apparent, that Mr. Rosny has suggested that the two are parts of one original work. The fact that we find here the missing half (by this we know that one-half is missing) of the 'titlepage' of the Troano manuscript is a very strong argument in favor of this view. Still, I am disposed to doubt its correctness, for the following reasons: 1°. On plates 39 and 40, upper division, we find an exact repetition of the five figures in the top division of plates 29 and 30 of the Troano manuscript; 2°. In the plates of the latter half, quite a number of numerals are introduced into the text, and joined to characters to which they are never attached in the manuscript; 3°. The form of the serpent-figures (no one can fail to remark the strong resemblance between the heads of some of these serpent-figures and the dragon-

heads on the pyramid of Xochicalco) ; 4°. The presence on plate 25 of a character found nowhere else in the Maya manuscripts except in the 'Dresden codex ;' 5°. The peculiar bird-headed figures on plates 20 and 21 ; 6°. The numerous eight-day columns in the latter half, and a number of other minor peculiarities which might be mentioned.

But be this as it may, it does not affect the value of the codex ; and we can join heartily with Mr. Rosny in esteeming it a truly 'precious document,' and extend to him our sincere thanks for bringing it to light.

Another peculiarity in this codex, worthy of special notice, is the *grand tableau cyclique*, as Rosny terms it, which commences on plate 13, and continues regularly in four lines on plates 14, 15, 16, 17, and 18.[1] The plan of this table (which is constructed upon an entirely different idea from the one which somewhat resembles it in form in the 'Codex Peresianus') so strongly resembles the cyclic tables, or Tonalamatl, in the 'Codex Bologna' and other Mexican codices, as to suggest the possibility of relation. In this case the series commences with *Ymix*, as Landa asserts was the custom. This table, as Mr. Rosny rightly affirms, furnishes us new data in relation to the Maya calendar, and may possibly enable us to untie some of the knots in that tangled skein.

A large portion of the introduction consists of a long extract from a paper on the Maya Calendar by Mr. Bouilhet presented to the Société américaine of France by Mr. Delaporte in 1880, but never before published.[2] The larger portion of this extract is devoted to a discussion of the Maya cycles, which leads the writer to the conclusion that the Ahau, or *Ahau-Katun* as he designates it, consisted of twenty-four years, and the Grand cycle of three hundred and twelve, agreeing in this respect with Perez. On the other hand, in attempting to adjust the years of the Maya system with those of the Gregorian calendar, he decides that the year 7 *Cauac* could not have been the first of an Ahau and at the same time the year 1392, as supposed by Perez. He agrees on both these points with my conclusions.[3] I judge from his language, and the figure of the calendar-wheel he gives, that he assigns *Kan* to the east, *Muluc* to the north, *Ix* to the west, and *Cauac* to the south ; and hence follows Cogulludo and Perez, in which I believe he is correct.[1]

[1] See note on p. 20, of my Study of the Manuscript Troano, where that part of the table found on plate 14 is given from the copy in Mr. Rosny's *Essai sur le déchiffrement*, plate 11.

[2] It was put in press, and the first proof struck off ; but for some reason its publication was then renounced. The title of the article, as we are informed by Mr. Rosny, who possesses the manuscript, is *Recherches mathématiques sur le calendrier Yucatèque*.

[3] Manuscript Troano, pp. 29 and 50.

Mr. Rosny calls attention to the fact, that most of the European *savants* appear to be unacquainted with the various works and articles relating to the antiquities of Central America which have appeared within the last few years in America, and in a note and elsewhere in his introduction mentions most of them.

The vocabulary at the end of the volume contains a list or series of the signs or symbols of the Maya days, and the numerous variants found in the different codices ; of the months ; of the numeral characters ; of other single characters, of which a probably or possibly correct signification has been given by him or other authorities ; and, lastly, a list of character groups which have probably been correctly determined. The entire list is numbered consecutively.

It may not be out of place to state here, that I have discovered with satisfactory certainty that No. 17 of this vocabulary, which is the same as fig. 96 (p. 159) of my 'Study of the Manuscript Troano,' and is found in all of the Maya codices, is not a variant of *Cimi*, as he supposes, nor a death-symbol, as I surmised, but a symbol of the number *twenty*, and, if phonetic, of the Maya word *Kal*. This is readily determined by its position in various series of numbers in the different codices ; as, for example, in the extended series in the third or lower division of plates 33 to 47 of the 'Dresden codex,' where the presence of days, by their succession, enables us to determine with absolute certainty the correctness of this conclusion. This fact compels me to differ from Rosny in his interpretation of group No. 224 of his vocabulary, and found on pl. 15.* of the 'Codex Troano.' Instead of *Cotz* (a 'divider' or 'sculptor') I would read *Cakal* ('twice twenty,' or 'forty'). Then this, together with the figure of the hatchet (which is certainly not phonetic), would signify that the artist should give twice twenty strokes or cuts, or draw twice twenty lines, with his machete, on the wooden image which he is carving.

The red diamond-shaped character so common in this codex in connection with numeral characters is also another symbol of the number twenty.

That Rosny is largely influenced in his interpretation of characters by Landa's alphabet and the names of the days, is quite perceptible in this vocabulary. I am satisfied that no

[1] I have discussed this subject in a paper to be included in the third annual report of the bureau of ethnology, now in the hands of the printer for publication.

decided progress can be made in deciphering these aboriginal documents until we break loose from these trammels, and use as a key the few characters which can be satisfactorily determined otherwise. The attempt, on the part of this author, to use the two classes as a basis, leads him into some inconsistencies. For example: he interprets his No. 176 (a cardinal-point symbol) as *Likin* ('east'), and No. 231 as *Ahau-al* ('enemy'); yet the leading character in both groups is the same, — the symbol of the day, *Ahau*. If the characters are phonetic, this is inconsistent; if they are not, then each must be determined independently.

I notice a number of clerical errors in the vocabulary, most of which can be readily corrected: therefore I only call attention to a few which may possibly lead to error. Under No. 174 the reference to No. 188 should be to 190. Under 178, *Sud* ('south') should be *Ouest* ('west'). Under No. 192 reference to 188 should be to 189. Under No. 200 reference to 199 should be to 201.

Of this work only eighty-five copies were published; and of these, as I learn elsewhere, but thirty-five or forty were to be offered for sale. CYRUS THOMAS.

KELLERMAN'S BOTANY.

The elements of botany, embracing organography, histology, vegetable physiology, systematic botany, and economic botany. Arranged for school use or for independent study. By W. A. KELLERMAN, Ph.D. Philadelphia, *Potter*, 1884. 360 p., 354 fig. 12°.

TEACHERS of classes composed of beginners, to whom they wish to impart some knowledge of botany aside from the rudiments of phenogamic analysis, have long felt the need of an elementary text-book a little more comprehensive in its scope than books of this grade usually are, and they turn to every book like Professor Kellerman's with some expectation.

So far as its scope is concerned, this little treatise leaves nothing to be desired. Besides the topics indicated on its titlepage, it briefly treats of vegetable paleontology and the geographical distribution of plants. In the main, each topic is fairly presented, considering the needs of the pupils for whom the book is written; but a lack of care in the final revision of the manuscript is frequently noticeable in badly constructed sentences; and those minor errors which so persistently make their way into text-books written by the most competent authors are found pretty liberally scattered through the pages. Even more serious than these are several statements, which, from their brevity or other causes, are likely to mislead the reader: e.g., the generalizations concerning plant-food (p. 12), the office of the leaf (p. 15), the absence of chlorophyll in parasites (p. 19), and metastasis (p. 107), most of which are qualified in other places; and the statements with respect to the decay of insects captured by Nepenthes (p. 107), the growth from a single cell in all Pteridophytes (p. 154), and the necessity of extraneous aid in the pollination of all orchids, which find no correction. The usual number of old errors are further disseminated; e.g., the cotyledonary nature of the persistent leaves of Welwitschia (p. 165), the fertilization of dioecious Saprolegnieae by spermatozoids (p. 134), the intercommunication of tracheides through their bordered pits (p. 75), and free-cell origin 'about new centres of formation' in endosperm, etc. (p. 81).

The writers of several recent text-books have been unfortunate in illustrating their works; old and well-worn figures being borrowed, or home-made drawings being cheaply photo-engraved, for the occasion. The book before us unfortunately suffers in both ways. Quite a percentage of the illustrations are taken from the floral advertisements of the late Mr. Vick, and it must be said that few of them convey a correct idea of the plants they are named after. Nearly three hundred figures are original, and, properly executed, would add very greatly to the value of the book. As it is, they reflect much credit on the industry of the author; but several fall quite as far short of reality as the so-called 'cat' whose problematical contour puzzled the readers of a zoölogical text-book not many years since.

While the book is unsatisfactory in its execution in many respects, it comes nearer to filling a serious gap in botanical literature than any other thus far published; and, notwithstanding its shortcomings, it is a welcome addition to the teacher's auxiliaries, its low price allowing it to be put in the hands of students who could not afford a more expensive book in addition to the systematic manuals used by most elementary classes.

THE SOCIETY OF MICROSCOPISTS.

Proceedings of the American society of microscopists. Sixth annual meeting, held at Chicago, Ill., Aug. 7, 8, 9, and 10, 1883. Buffalo, *Haas & Klein, pr.*, 1883. 4 + 275 p., illustr. 8°.

THE proceedings of this society are published with commendable promptitude, and

are printed with general accuracy and neatness. The proceedings are given in full, together with certain reports and papers read. Of the reports, the most important is that of Prof. W. A. Rogers, upon the standard micrometer: it bears the stamp of that thoroughness and exactitude which characterize all Professor Rogers's work. This standard is a platin-iridium bar prepared and authenticated by the U.S. bureau of weights and measures: it is very well ruled, and the error in each of the ten one-millimetre spaces has been carefully determined. The bar will be preserved by the society with due care, and proper copies prepared of it.

The volume opens with President Albert McCalla's address, 'The verification of microscopic investigation' which is followed by twenty-six papers. These last are mostly by amateurs, and show it, for the most part, more plainly than is consonant with a high scientific value. There is, we believe, not more than a single communication which appears to be the result of a serious and prolonged research by an experienced investigator.. In fact, a society of so-called microscopists must necessarily be an association principally of amateurs, because the professional worker is not classified according to the instrument he uses, but according to the subject he studies: the amateur studies, *non multum, sed multa*, and so may be a microscopist. Yet we find in the volume articles of interest and value. Among these, we may signalize Dr. Blackham's very sensible article on the selection of objectives; Dr. Holbrook's, on the nerves of the kidney, in which the valuable method of making frozen sections of fresh tissues to be treated with gold is described; and Mr. Belfield's, on the detection of lard-adulterations (if his results are confirmed, they will be a valuable addition to the means of hygienic supervision). Dr. Clevenger's article on the brain is fortunately given only in abstract. The remaining essays are for the most part light: some betray a lack of acquaintance with scientific literature, and a few are treated kindly by being left uncriticised.

The society is doing useful work; and, as its activity and experience increase, we may hope for a constant elevation of its scientific standards. We expect that the future volumes of its proceedings will contain a still larger proportion of valuable researches; but we think the society will achieve its highest utility if it constantly inculcates the importance of perfected methods of work, and fosters and extends technique, the *sine qua non* of progress in microscopy.

DARWINISM.

Darwinism stated by Darwin himself. Characteristic passages from the writings of Charles Darwin. Selected and arranged by NATHAN SHEPPARD. New York, *Appleton*, 1884. 16+351 p. 12°.

Charles Darwin und seine lehre. Aphorismen gesammelt aus Darwin's eigenen werke und den werken seiner vorgänger und zeitgenossen. Leipzig, *Thomas*, 1884. 8+442 p. 12°.

It is rather remarkable that the idea of compiling a series of extracts from the writings of Darwin should have occurred, after so long an interval, to an American and a German at the same moment. No large theory of the operation of natural causes has ever had so brief a struggle for existence, or penetrated so rapidly and so deeply into the general mode of thinking, as Darwinism; and if no great necessity has been felt hitherto for an abridgment of his works, it is because they are so admirably clear and of such absorbing interest, that the general reader has not had much trouble in getting through them all in the original form. Mr. Romanes, however, says that admirers of Mr. Darwin's genius are frequently surprised at the ignorance of his work which is displayed by many persons who cannot be said to belong to the uncultured classes; and to those who have read nothing more than Mr. Romanes' own excellent presentation of the scientific evidences of organic evolution, 'Darwinism as stated by Darwin himself' will be just what is needed for their next stage of development.

It gives extracts, of a page or two in length on the average, from all Darwin's books. The order followed in the arrangement is not exclusively that of the books themselves, but is designed to present the reader with a connected view of Darwin's researches on plants and worms; on the development hypothesis in general, and its application to man in his physical and moral aspect; and on the influence of natural and of sexual selection, and of geographical distribution. The design of the compiler is carried out with a reasonable degree of success. No scientific man, of course, who has any regard for his reputation, openly reads an abridgment; but the general reader may well be thankful for this compilation, and the greatest physicist in the world is, after all, nothing more than a general reader in paleontology and the theory of groups.

What strikes one most, on turning over these pages, is the smallness of the addition which has been made to the general development theory since the publication of Darwin's two great works. Little or nothing has been done to change the main line of argument, or even

to increase its cogency. It is probably the only instance of a theory which has sprung from its author's brain fully grown, and armed at every point against its opponents; and it is in remarkable contrast to that great engine of mathematics which was invented by such men as Newton and Leibnitz, and which, nevertheless, has waited until comparatively recent times to be placed upon a thoroughly sound basis.

It is seldom that the press of any country brings out so poor an example of book-making as 'Darwin und seine lehre.' Its ostensible reason for existence is some recent action of the Prussian Diet; but the Prussian delegate must be a curious man, if he can shape his political course from any information which this book contains. There is no connection between the successive 'aphorisms,' and there is no reference to the volume or page from which they are taken. The extreme irksomeness of reading elegant extracts on any subject is naturally greatly intensified when the subject is one which depends for its interest on the cumulative nature of the evidence brought to bear upon it. One is surprised to find how Platonic an air sentences of Darwin's may have when separated from their context. No one would have believed that he has uttered so many fine sentiments. A selection from this selection would make a very respectable Darwin birthday-book. The extracts from predecessors and contemporaries, instead of making it plain just what had been said in the direction of Darwinism before Darwin's time, are also totally without any order or connection. They consist in such passages as these, — "Man is the great dash (*gedankenstrich*) in the book of nature" (*Jean Paul*); "Every being is as happy as it feels itself, not as I, with my intelligence, would feel in its place" (*Hartmann*); "Man was developed, not created" (*Oken*); "He who exists not, feels no kind of pain; annihilation, therefore, is not an evil" (*Fichte*), — together with others somewhat more to the point, chiefly from Haeckel and Büchner.

HOUZEAU AND LANCASTER'S METEOROLOGY.

Traité élémentaire de météorologie. Par J. C. HOUZEAU and A. LANCASTER. 2e ed. Mons, *Manceaux*, 1883. 324 p., illustr. 24°.

THE *Bibliothèque belge* for popularizing the sciences and arts includes this small volume as its second number. The authors have not succeeded in making it a very notable book, for it has about all the faults common to the many works of its class. It is essentially old-fashioned, except in the chapters on weather-services, which have a more modern flavor, although not of the best. Valuable space is given to the description of such instruments as the thermometer and barometer, which must already be familiar to a reader who has studied physics enough to appreciate the mention of expansion, radiation, and many other terms that receive no special explanation. The encyclopedic method is attempted: there seems to be a desire to say something of every thing, and consequently all mention of the *bora*, *mistral*, *föhn*, *sirocco*, *solano*, and *norther* is crowded into seven lines. It is a great mistake to suppose that the readers of popular scientific books will be content with such unsatisfying statements. The *föhn* may be a 'dry and warm wind,' but why is it so? The explanation involves some of the most recent and important applications of physics to meteorology, and a deliberate description of it would well replace the chapter on terrestial magnetism. But besides these errors, as they seem to us, in the plan of the book, there are implicit and explicit errors of fact. The low temperature of winter is regarded as the effect of the greater thickness of atmosphere through which the solar rays then pass, and no mention is made of their oblique incidence on the ground. The old error of two northern poles of minimum annual temperature is repeated. The less area of ice in the arctic than in the antarctic seas "must be attributed to the neighborhood of great continents which extend to the equator, and which transmit from point to point the heat thrown on the tropics." The maximum density of sea-water is given as 4° C. The equatorial current of the Indian Ocean is described as passing round the Cape of Good Hope, up and across the Atlantic Ocean, through the Gulf of Mexico, and thence as the Gulf Stream to Norway, without a word about the many branches on the way. Cloud-particles are considered chiefly vesicular; and their suspension in the air is said, before all, to be due to their electricity, which repels them far from the ground. The oblique motion of the trade-winds is wrongly explained, as usual, and part of their velocity is incorrectly regarded as an effect of the earth's rotation: they would flow faster if the earth stood still. The strength of storms is represented to be the simple direct action of the low pressure at their centre. 'Cyclone' is applied only to the Indian Ocean, and is said to be synonymous with 'tornado' in the United States. We cannot recommend the book.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Division of chemistry. — During February, Prof. F. W. Clarke and Dr. T. H. Chatard completed analyses of waters from Utah Hot Springs, Lake Tahoe, and from Alum Creek in the Yellowstone National Park. They have also analyzed some rocks and sediments collected in the Great Basin. —— Dr. Chatard has begun investigations into a new method of silicate analyses, the results of which promise to be of importance. —— Professor Clarke has analyzed halotrichite and alunogen from a large deposit at the head waters of the Gila, in New Mexico; saussurite from California; allanite from Topsham, Me.; a mineral near cimolite from Norway, Me.; a handsome chlorite from Georgetown, D.C.; and an exceedingly interesting variety of pectolite, simulating jade, from Alaska.

Professor Clarke has also completed the analyses of two more mineral-waters from Montana, collected by Dr. A. C. Peale last summer. One of them is a calcic thermal water from a spring in Emigrant Gulch, on the west side of the Yellowstone valley, opposite Bottler's ranch. This water contains .2350 of a gram of solid matter to the litre. The temperature of the water at the spring is 38°.8 C., and the flow of water is large. The other water is also from the Yellowstone valley, the spring being situated on the upper waters of Mill Creek, about ten miles due east from Riverside, one of the stations on the Park branch of the Northern Pacific railroad. Professor Clarke finds this to be a good mineral-water. It contains 3.8125 grams of solid matter to the litre, mainly sodium, magnesium, and calcium carbonates, with considerable sodium sulphate, and small proportions of chlorides. The water also contains iodine; but the quantity brought to the laboratory was too small to estimate its amount. This water is very agreeable to the taste. It resembles very much the 'Apollinaris' water from the valley of the Ahr in Prussia; and from this resemblance the springs have been named the 'Mill Creek Apollinaris springs.' The water is cold, having a temperature of 4°.5 C.

Mr. F. A. Gooch, formerly of the Northern transcontinental survey, has been appointed assistant chemist, to begin work in the laboratory at Washington April 1. —— Messrs. Barus and Hallock at the laboratory at New Haven, needing some capillary wire tubes, and being unable to find any, have succeeded in making them at the laboratory.

Crater Lake, Oregon. — Among the interesting places visited by Mr. J. S. Diller, in his reconnoissance of the Cascade Range last summer, was Crater Lake, about two or three miles west of Mount Scott. This is a body of water some three miles in diameter, lying in a depression some two thousand feet below the general level surrounding it. The sides are in general perpendicular, and the water is of a most beautiful tint. Toward the western end of the lake there is a small conical island, the rock of which resembles basalt, although Mr. Diller has not yet made a careful examination of it. The rocks forming the walls of the lake are andesitic. The general elevation of the country immediately about the lake is between two thousand and three thousand feet lower than the summit of Mount Scott. Capt. Dutton is convinced, from Mr. Diller's description of the lake, that it is homologous with the craters studied by him in the Hawaiian Islands. To the latter Capt. Dutton gives the name of 'caldeiros.' He says the first view of them does away with the idea that they are ordinary craters. They are huge caldrons or boiling lakes of molten rock.

Miscellaneous. — Capt. Dutton has received letters from Honolulu, by the steamer leaving there March 3, which state, that, for the few days preceding that date, the 'red sunsets' have been exceedingly brilliant. —— During February, Mr. Vanhise, one of Mr. R. D. Irving's assistants, prepared about fifty new thin rock-sections, among which were a large number of greenstones.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American society of civil engineers.

April 2. — The subject for discussion was the reduction of grades necessary to be made upon railway-curves to compensate for the increased resistance to the traction of the locomotive when traversing curves, in comparison with resistances encountered upon straight lines. The various forces composing such resistances have been combined in a formula deduced mathematically; but careful experiments which have been made tend to show that no formula has yet been found which is of general application. The rules adopted upon various great railway-lines were stated; but it was plain that additional information must be obtained before positive rules of general application could be given.

Chemical society, Washington.

March 27. — Papers were read as follows: F. W. Clarke, A new variety of pectolite from Alaska. —— Dr. J. H. Kidder, The use of the Nessler reagent in air analyses. In several cases the air-washings which were under examination gave a distinct, clear, green coloration in place of the characteristic yellowish-brown precipitate produced by ammonia. This color was also found in a few experiments upon rain and snow waters, but never in dealing with drinking-waters. Dr. Kidder is inclined to ascribe the new

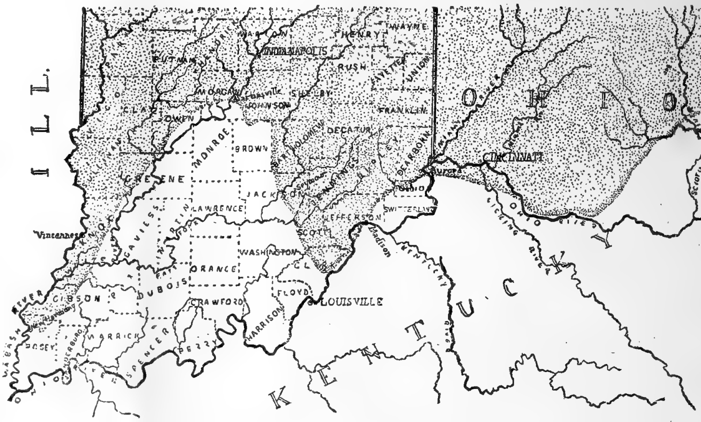
reaction to some organic amine, and hopes to continue the investigation of it. —— C. A. Crampton and H. W. Wiley, Bi-rotation of commercial starch-sugars, and a method of analysis based thereon. —— G. L. Spencer, A method for the determination of phosphoric acid in commercial fertilizers. This was essentially an improvement on the volumetric uranium process. —— H. W. Wiley, A method of determining the end reaction in sugar-reductions.

San Diego society of natural history.

March 7. — Mr. D. Cleveland made remarks relating to a tubular stone found in Temecula Cañon, supposed by him to have been used by the Indians as a pipe. Mention was also made of the Indians using the leaves of several species of Nicotiana (N. Clevelandi and N. Bigelovii) as a substitute for tobacco. —— A medium-sized olla was described by Mr. C. R. Orcutt as having been made by the Indians of Lower California in imitation of a teapot, with a nose and perforations in the side of the unglazed pot, and which was used by them to steep the leaves of Mentha Canadensis, L. —— Miss K. O. Sessions presented specimens of a rock from San Benito county, Cal., which is largely used in the adulteration of soap, and the best substance known for that purpose. —— Mr. Jos. Winchester presented a chart representing the comparative meteorology of San Diego (on San Diego Bay) and Poway (twelve miles from the coast) during the last five years; showing that the rainfall is greatly less near the coast than among the hills, while the humidity of the atmosphere near the coast is greater for ten months in the year than away from the coast. The explanation of the chart by Mr. Winchester was followed by a general discussion. —— Mr. C. R. Orcutt read a few notes on the native cacti, mentioning several undescribed species of this county and Lower California.

NOTES AND NEWS.

THE detailed results of Mr. G. F. Wright's studies in 1882 and 1883, of the southernmost drift margin in the Ohio valley, are recently published by the Western reserve historical society. The pamphlet includes a revised reprint of Mr. Wright's lecture on glacial phenomena in the United States, from which we copy, in reduced form, the accompanying figure of part of the drift boundary in the states examined. Several other cuts illustrate the boundary by counties in much greater detail. The description of the district opposite Cincinnati, where the effects of ice-action are traced across the Ohio into Kentucky, is still confessedly incomplete; but, so far as observed, there is no question of the presence of true, unmodified glacial drift south of the river. It is to be noticed that another invasion of Kentucky is marked on the map here given, farther down the valley, at Madison; and that the retreat of the glaciated area towards Indianapolis seems to mark the division between two lobe-like extensions of the drift, which are now found to be frequently characteristic of the old ice-front, wherever studied in detail. The report attempts little of novelty in its subject-matter, being confined closely to questions of distribution; but the continual repetition of the familiar evidences of glaciation, — scratched rocks, heavy till, large granite bowlders, kames, and kettle-holes, — limited by a line of great irregularity, both horizontally and vertically, presents precisely the definite commonplace proof that is wanted in connection with the many scattered observations heretofore made.



MAP OF SOUTHERN INDIANA AND OHIO, SHOWING GLACIAL BOUNDARY.

— The trustees of the Peabody academy of science at Salem have decided to make a fireproof additional building, seventy by fifty feet, and two stories high. The additions to the ethnological collections, especially from Japan and Corea, have been very considerable during the past year.

— A recent calculation of the population and area of Australia states that there are only three human beings to every four square miles.

— The London society of arts has received a donation of twelve hundred pounds from one of its members, Mr. William Westgarth, to be expended on prizes for the best essays on dwellings for the poor, and the reconstruction of central London. The essays should include the following points: 1. The reconstruction of the central part of London with regard to the plan of the streets; 2. Removal of the old and poisoned soil; 3. Re-arrangement of the levels, and provision of subterranean ways for the accommodation of electric wires, pipes for water-supply, sewage, etc., and also provision for warehousing.

The prizes for these essays will be one of five hundred pounds, and one of two hundred and fifty

pounds. Three prizes, of one hundred and fifty pounds each, are to be given, either separately or to the writer of the larger essay, for the best treatment of the engineering, the architectural, and the sanitary considerations involved in the scheme. Mr. Westgarth's views as regards the prizes, and his hopes as to the value of the essays, may be fairly understood from a paper read by him at the Society of arts on Feb. 6, which embodied his own ideas on the question. The prize will be adjudged on Dec. 31, 1884.

— The researches of Dr. Angus Smith, one of the English inspectors under the Rivers pollution prevention act, have led him to the discovery that in all natural waters sugar ferments, and hydrogen gas is given off. The proportion of hydrogen given off varies with the organic impurity of the water, from the mountain stream to the worst sewage, so that the proportion of hydrogen evolved appears likely to prove a quantitative test of the activity or virulence of the microbes present in the water. Dr. Angus Smith's researches will probably be embodied in his next report. The importance of his discovery will be plain to every one familiar with recent micro-biological research, and suggests a test of the miasmatic condition of particular soils, and, of course, localities.

— A new French work by Dr. Bordier of the Paris School of anthropology, called '*Géographie médicale*,' gives an account of the geographical distribution of diseases, including a mass of information bearing on the relations between particular maladies, and climate, topography, and even race.

— We learn from the *Observatory* (March), that, in consequence of M. Houzeau's resignation of the directorship of the Royal observatory at Brussels, a committee, consisting of MM. Liagre, Mailly, and Stas, has been appointed to preside over that institution, and the following appointments have been made: M. Niesten has been appointed chief of the department of mathematical astronomy; M. C. Fievez is temporarily intrusted with the direction of the physical department, and, with M. Lagrange, has been promoted from the rank of assistant to that of astronomer; and M. Vincent has been promoted to the rank of meteorologist. Vol. iv. of the new series of annals has just been published, and contains, in addition to the meridian observations for 1879–81, drawings of the moon, observations of Jupiter's satellites, physical observations of Jupiter and of comets (*b*) and (*c*) 1881, and a study of the solar spectrum.

— The hydraulic method of mining has lately been used to remove some bluffs at the opening of the Dutch Gap canal. There had been trouble from caving in, obstructing the entrance. At the suggestion of Mr. C. P. E. Burgwyn, a powerful stream of water was directed against the banks, while a strong enough current was running to carry off the material as it fell, with a result highly satisfactory, as reported.

— It is said that a recent cold blizzard in southern Oregon killed thousands of robins and blue-jays, which usually winter in this latitude with safety. The birds have had no such experience since 1862.

— The bulletins of the Paris society of anthropology are always especially full on the subject of anatomy in its bearings on the natural history of man. Part iii. of vol. xvi. contains some very interesting papers of this description. M. C. Ikow, in discussing the color of the skin, eyes, and hair, says that a sufficient number of individuals in most ethnic groups will display a regular gamut of shades. Our knowledge of pigment itself is very imperfect. We do not know whether there is one pigment or whether there are several. It would be very useful to anthropology to know the chemistry of these pigments, the conditions of their occurrence, the influence of external and internal circumstances in modifying them. Domestication in animals produces great variability. It is therefore allowable to suppose that the endless variety in the environment of man occasioned by his occupying nearly all the earth, the endless variety of functional activities occasioned by the great range of food, etc., act similarly to domestication in animals. It may not be the sun immediately that turns the negro's skin black, and the Russian's hair white; but, mediately, the myriad physical movements consequent upon the sun's action act together to bring about the changes under discussion. Heredity must not be overlooked among the conservative powers. Mr. Ikow considers that there are fundamental eye-colors, just as there are fundamental race-forms. In opposition to Broca's brown, green, blue, and gray fundamental shades, he maintains that gray and blue eyes have no pigment whatever, their color being due to the structure of the iris. He further claims that Broca's colors correspond to no natural groups of humanity. The classifications of colors in the eyes, hair, and skin, are given in tabular form.

The most elaborate paper in the number is by Dr. Réné Collignon (pp. 463–526), upon the anthropometric elements of the principal races in France. It is well known that an effort is now making to replace the slow and unsatisfactory measurement of skeletons, of whose racial identity there must always be some doubt, with the much more convenient examination of the living. The Paris school of anthropology has two sets of observations, called the full and the abridged scheme; and the latter of these has been taken on a hundred Celts, a hundred Cymrians, fifty Lorrains, and thirty Mediterraneans (Catalans). These two hundred and eighty individuals are compared in every way which Collignon's genius could devise to give a scientific result. The variations imputable to height are the following: when the height increases, it is due to the augmentation of the length of the legs; all other parts diminish proportionally. So that the people are not far from wrong when they say of a tall man, 'He is all legs.' The only part of the body (except the special measures of the head and face) sensibly affected in its proportions by race is the trunk: it is long in the Catalans, short in the Celts, medium in the Cymri.

— The council of the Academy of natural sciences of Philadelphia announces that Prof. H. Carvill Lewis will deliver a course of twenty lectures upon the geology and mineralogy of eastern Pennsylvania,

beginning April 15. Every alternate lecture will be given in the open air, at different localities of geological interest in the neighborhood of the city. These field-lectures will take place on Saturdays, the excursions occupying the greater part of the day. The final field-lecture (June 21) will treat of coal and the methods of surface and underground mining, as illustrated in the neighborhood of Hazelton, Penn. Visits will be made to the mines of Mr. Coxe, at Drifton, and to the Hollywood colliery, near Hazelton, where the end of a coal-basin has been completely uncovered.

— It is hoped that the next annual meeting of the National educational association of the United States, to be held in the capitol building, Madison, Wis., July 15–18, will be the largest educational meeting ever held in this country.

— An extended course of instruction in mineralogy will be given by Prof. H. Carvill Lewis, at the Academy of natural sciences, Philadelphia, during the coming autumn and winter.

— The two remaining lectures of the course of free lectures under the auspices of the New-York academy of sciences, are, April 21, Recent discoveries in the prehistoric mounds of Ohio, by Prof. F. W. Putnam of Cambridge, Mass.; and, May 19, The glacial epoch in North America, by Prof. H. Carvill Lewis of Philadelphia.

— Dr. L. Waldo has just completed the erection of a normal clock at the Yale college observatory, to be used as a mean-time standard in the horological work of that institution. The movement and pendulum are parts of the gravity escapement clock built by Richard Bond (No. 367), and which had a phenomenal record under Mr. Hartnup at Liverpool, and later under Prof. W. A. Rogers of Cambridge. The case from Dr. Waldo's designs is built of cast-iron, with planed back and front, to which are clamped the plate-glass doors. The entire case rests upon two brick piers, which rise to the height of the movement, and insure stability to the pendulum suspension. Thermometers, a barometer, and a cup of calcic chloride, are placed within the case, which can be exhausted to any barometric pressure desired by an air-pump attached to its side. The escapement, and arc of vibration, can be observed and adjusted with the greatest accuracy. The clock is erected in the clock-room of the observatory, which was specially built to secure uniformity of temperature.

— During the week from June 28 to July 5, inclusive, it is proposed to institute a summer school of geology at the Delaware Water-Gap, Monroe county, Penn. Those desiring to join this class should make application to Prof. H. Carvill Lewis, Academy of natural sciences, Philadelphia.

— In the neighborhood of the Puerto de Toledo, Madrid, the manufacture of artificial whalebone has been started. It is made from the horns of black cattle and buffaloes. It is said that the factory is provided with all modern improvements, and that its products are already competing successfully with similar articles which are imported from abroad.

— The *Engineer* of Feb. 1 gives a very easy practical suggestion for preventing the boiler-explosions which occur so frequently in the early morning, while the boilers are being fired up, after standing with fire in all night, and the water on the simmer. It is suggested that a little air and cold water should be forced into the boiler before vigorous fires are made, so as to impart some air to the water, and lessen its super-heated condition.

— The new Sydney paper, *The Australian graphic*, is illustrated by typographic etchings on glass plates made by the process of Mr. H. S. Crocker. The writing or drawing is executed with a resist crayon, made of a waxy material; and it need scarcely be said that hydrofluoric acid is used as the etching-fluid. It has been noticed that the tendency to undercutting is remarkably small, so that no precautions are required but an occasional stopping-out of the finer parts. The glass plates are cemented down on metal blocks for use in the printing-machine; but it is not stated how the clearing-out of large whites, and the turning of the blocks, are effected. It is said that the inventor originally intended to print from electrotypes taken from the glass; but this is found unnecessary in practice, as no inconvenience is caused by the use of the glass itself in the printing-press.

— M. Poincaré has been investigating the physiological action of petroleum-vapors, and gives his results in the *Journal de pharmacie et de chemie*, vii. 290. He found that an atmosphere charged with petroleum-vapors, such as is respired by workmen engaged in the petroleum industry, proved fatal to guinea-pigs after periods of exposure of from one to two years. Dogs and rabbits, under similar treatment, manifested languor, and loss of appetite. The work-people themselves complain only of an irritation of the membrane of the nose, and headache. It is nevertheless evident, that precautions should be observed, to prevent, as much as possible, the respiration of these vapors by the human subject.

— The fourth part of the transactions of the Ottawa field-naturalists' club shows marks of unusual activity on the part of so small a society (one hundred and thirty members), printing reports of no less than six different branches. The scientific papers are very fitly concerned mostly with local natural history.

— Sixty-nine species of butterflies are credited to Maine, and briefly described by Prof. C. H. Fernald in a paper of 106 pages, appended to the annual report of the State college of agriculture and the mechanic arts, at Orono, Me., for 1883.

— The catalogue of stars prepared from observations at the Glasgow observatory, extending over the years 1860 to 1881, has just been published by Professor Robert Grant, the Royal society having contributed largely toward the expense of printing from the government-grant fund.

— Mr. W. Mathieu Williams, in his usual science notes for the *Gentleman's magazine*, mentions an ingenious application of oxalic acid by saturating blotting-paper with it. The blotting-paper will then not

only absorb the excess of ink from a blot, but will remove the blot altogether; provided, always, the ink be of the old-fashioned kind, unmixed with indigo or aniline color. Such blotting-paper may, however, deal with signatures as well as blots: this is one reason for using the inks that are not entirely dependent upon the iron salt. Oxalic acid, however, is not very dangerous as a means of fraud, seeing that a trace of the writing, or the blot, remains; and this may be brought out again into full legibility by adding ferrocyanide of potassium or gallic acid.

— In his lecture given in London on house-drainage, Capt. Galton drew attention to the formation of nitre in the organic remains in the subsoil of old cities and villages. The wells of Delhi were at one time completely contaminated thereby; and there are many factories of saltpetre in India whose supplies are derived from this source. During the English blockade of European ports, Napoleon I. procured his nitre for gunpowder from the subsoil of Paris. The *Engineer* remarks that the conversion of ancestors into explosive material is more objectionable than Shakspeare's ultimate fate of Caesar, — to 'stop a hole to keep the wind away.'

— The Worshipful company of grocers, one of the old London guilds, has endowed a prize of a thousand pounds, to be offered once in every four years, and to be awarded for the discovery of any proof with regard to a subject in connection with sanitary service named by the company. The first essays for this discovery prize which is to be open to universal competition, British and foreign, are to be sent in by Dec. 31, 1886, the following problem being the test: "the discovery of a method by which the vaccinum contagium may be cultivated apart from the animal body, in some medium or media not otherwise zymotic; the method to be such that the contagium may be, by means of it, multiplied to an indefinite extent in successive generations, and the product after any number of such generations shall (so far as can within the time be tested) prove itself of identical potency with standard vaccine lymph."

— The memorial tablet to Elihu Root, lately professor of mathematics and physics in Amherst college, and which was destroyed in the burning of the Walker Hall two years ago, has recently been restored to its former location in the philosophical lecture-room of that building. The inscription reads as follows: —

"In memory of
ELIHU ROOT,
Professor in this college for four years.
Born Died
Sept. 14, 1845. Dec. 3, 1880.
'Speremus.'
A.D. 1883, restored from the fire of March, 1882."

This memorial was originally erected in June, 1881, by the graduating class of that year.

— The *Seconde société de Teyler*, of Harlem, has offered again its gold medal for a satisfactory essay "to furnish a critical study of all that has been said for and against spontaneous generation, especially during the last twenty-five years." The competing essays should be sent to the society before the 1st of April, 1886.

— By a happy accident, just as a plan for a topographical survey of Massachusetts is being considered, the discovery has been made of some original unpublished documents, relating to the former geodetic survey, by Borden. One is a letter of forty pages, addressed to the Hon. Theophilus Parsons, then chairman of the joint committee of the legislature, in which Mr. Borden reviews the whole matter of the state survey, describing in a very simple manner the methods used and the results obtained, and concluding with a detailed statement of the expense of the work from 1830 to 1841: the other is a paper addressed to the American academy of arts and sciences, dated August, 1850, in which is described in great detail, accompanied by carefully-drawn plates, the base-measuring apparatus, devised, constructed, and used by Borden in measuring the base-line in the Connecticut valley. The work done with this apparatus was of the most accurate character, the difference between two measurements of a line over seven miles long being less than a quarter of an inch. This paper was never sent to the academy; but, after various wanderings, both have reached the hands of Professor Vose of the Massachusetts institute of technology, who has presented them to the academy. It is to be hoped that the academy will print them in full at an early day.

— Messrs. Henry Edwards and S. Lowell Elliot announce that they will publish from time to time independent monographs of North-American Lepidoptera, with colored illustrations, prepared by different American entomologists. Ten are already announced by Dr. A. S. Packard, Messrs. Roland Thaxter, Eugene M. Aaron, R. M. Stretch, W. H. Edwards, B. Neumogen, and the futherers of the enterprise. They are to be published at only a slight advance upon the actual cost.

— In view of the communication by Dr. Bradner to the Academy of natural sciences at Philadelphia, reported on p. 334 of *Science*, a correspondent from Newark, O., warns us that any inscribed stones said to originate from that locality may be looked upon as certainly spurious. Years ago certain parties in that place made a business of manufacturing and burying inscribed stones and other objects in the autumn, and exhuming them the following spring in the presence of innocent witnesses. Some of the parties to these frauds afterwards confessed to them; and no such objects, excepting such as were spurious, have ever been known from that region.

— Mr. Winfred A. Stearns proposes, if a sufficient number of subscriptions can be procured, to publish at Amherst, Mass., under the auspices of the Massachusetts agricultural college, a scientific journal, to be devoted exclusively to the interests of natural history in the state of Massachusetts, and to be called the *Bulletin of the natural history of the state of Massachusetts.*

— Among recent deaths, we notice those of Dr. J. W. Gintl, professor emeritus of physics and mathematics, at Graz, Dec. 22, 1883, in his eightieth year; Ch. H. Merrifield, Jan. 1, at Hove; Professor Hermann Schlegel, director of the museum of Leyden; Prof. H. C. Berghaus, the well-known geographer, in his eighty-seventh year, at Stettin, Feb. 17; Quintino Sella, president of the *Accademia dei lincei*, at Biela, March 14; and Dr. E. Behm, the geographer.

— M. Adams, says the *Athenaeum*, has successfully established an optical telegraph between the islands of Mauritius and Reunion, a distance of two hundred and forty-five kilometres. Observers in Mauritius can read the signals without difficulty, and the arrangements for announcing cyclones are in process of completion.

— Russia has two polar stations on Weyprecht's plan, — one at Sagastyr (the mouth of the Lena), and the other at Little Karmakuly, Moller Bay (the west coast of Novaia Zemlia). According to the latest news, which is, as may be understood, slow to reach St. Petersburg, the Lena station was in good condition, and is to be continued until July, 1884. Thus the stations which are most interesting and most difficult to reach (the Lena and Lady Franklin Bay) will have the longest course of observations. The Novaia Zemlia station has finished its observations; and the members, consisting of Lieut. Andrejew, Midshipman Wolodkowsky, Drs. Grinewetzky, Kriwoskeya, and seamen, have returned.

Lieut. Andrejew, in a lecture before the Geographical society, gave the following facts in regard to the station. The latitude of the station was determined by observation of the sun and stars; the longitude, by double chronometer comparison between Karmakuly and Archangel. The observations comprised hourly reading of the magnetic and meteorological instruments, with more frequent reading of the former on stated days and during magnetic disturbances. The results have not yet been calculated. Scurvy was prevented by exercise and the use of good fresh food, and the health of all was good. The death of one seaman happened under somewhat strange circumstances: he disappeared, and after long search was found undressed, in the snow, with his legs frozen. They were amputated, but he died soon after.

— We have already referred to the observations of Lessar in regard to the character of the valley or depression which had been regarded as an ancient channel of the Oxus, south of Khiva. From Bala Ichemi he turned to the eastward, to Kavakli, on the Amu Daria, and, according to letters just received, found no trace of any ancient river-bed. Gen. Stebnitzki and other explorers of this region do not accept as yet the opinion of Lessar in this particular.

— A very interesting addition to the mollusca of the United States is made by Stearns, who describes, in the *Proceedings* of the Philadelphia academy, Pyrgula nevadensis, from specimens obtained by Xenos Clarke and R. E. Call, at Pyramid and Walker's lakes, Nevada. The species is found living in the depths of the lakes, and fossil on the shores; but the specimens collected all appear to have been destitute of the soft parts, for which reason the generic relations cannot be said to be definitely settled, though probably correctly surmised. A fossil shell had previously been described from the post-pliocene of Illinois, by Wolf; but its affinities may be said to be very imperfectly determined. The identity of Tryonia clathrata Stm. with Amnicola protea of Gould, which Mr. Stearns seems to consider as undoubted, is deserving of further investigation at least; as in many thousands of the latter we have never seen a specimen of Tryonia, or any approximation to one, judged by the standard of Stimpson's original specimens and figures.

— Professor Boyd Dawkins reports the discovery of a skull of the musk-ox (Ovibos moschatus) in the forest-bed of Trimingham, near Cromer, — a formation which is believed to be certainly preglacial. The discovery is considered to add to the evidence that the glacial epoch does not represent a condition of environment separating two distinct faunas.

— The agricultural and mechanical college of Texas has issued a bulletin in which it calls attention to the need of a more careful study of the agricultural necessities of the state, and offers the advantages of the college for analyses of soils and fertilizers, and experiments on methods of feeding, on the grasses suitable to Texas, etc. A special request is made for samples of wool.

— It is stated that Senhor Antonio Lopez Mendes is about to undertake an important study of the Amazon basin, including the main river and its affluents to their westernmost extension.

— Vols. v. and vi. of the census reports, comprising the report upon cotton-production by Prof. E. W. Hilgard, have just issued from the government printing-office. These volumes contain respectively 924 and 848 pages, and are amply illustrated with maps showing density of cotton-production and classes of soils. The great degree of attention given to this branch of agriculture by the census is amply warranted by the importance of this industry, the product of which, during the census year, was valued at nearly $300,000,000. A happier selection than Professor Hilgard for carrying on this investigation probably could not have been made. His long study of the geology and soils of the lower Mississippi states, with the agricultural methods practised there, enabled him to bring to this work a vast store of knowledge which was directly applicable to the subject.

The report is in two parts. The first contains a chapter on the general subject of cotton-culture in the United States; an extended table of measurements of cotton fibre from all sections of the cotton-belt; a chapter on the uses of cotton-seed and cotton-seed oil, and one upon soil investigations. The body of this part is taken up with the detailed report upon cotton-culture in the states of Louisiana, Mississippi, Tennessee, Kentucky, Missouri, Arkansas, and Texas, and Indian Territory. Part ii. consists of similar

reports upon Alabama, Florida, Georgia, South Carolina, North Carolina, and Virginia. An appendix to part ii. contains notes upon California, Utah, Arizona, and New Mexico, considered in relation to their possibilities as cotton-producing states or territories. Of these detailed reports, Professor Hilgard, besides planning and supervising all, wrote those upon Louisiana and Mississippi, and the notes upon California, etc. To Prof. R. H. Loughridge were assigned those upon Georgia, Missouri, Arkansas, Texas, and Indian Territory; to Prof. James M. Safford, Kentucky and Tennessee; to Dr. E. A. Smith, Alabama and Florida; while Prof. W. C. Kerr contributed the reports upon North Carolina and Virginia, and Major Harry Hammond that upon South Carolina.

All these state reports, with the exception of that relating to South Carolina, are upon the same plan. Each opens with tables of the leading agricultural statistics of the state. Then there follows a description of the topography, climate, and soils, with numerous analyses of the latter, — a subject to which Professor Hilgard is disposed to attach great importance. This is followed by agricultural descriptions of the several counties, and by cultural and economic details, which are derived from answers to schedule questions.

The report upon each state is followed by an index, evidently with the intention of making a separate issue of each report; and the entire report is closed with a very complete general index.

— Mr. Isao Iijima, a Japanese student under Professor Leuckart, has recently submitted a dissertation to the University of Leipzig for obtaining the degree of Ph.D. The judgment passed by the examining committee was, "Dissertatio, egregia — Examinatio, summa cum laude." Mr. Iijima has won his degree within two years from the time of his arrival in Germany. Students usually require from two to three or more years to accomplish the same end.

— The Johns Hopkins university circular for March prints an unusual number of scientific notes, abstracts of papers read before the various associations to which the active life of the university has given birth. It notes, also, the formation of a new archeological society, and of the purchase of a considerable mineralogical collection, which has been placed in charge of the associate in mineralogy, Dr. G. H. Williams. Extracts are given from Dr. Hartwell's address on physical culture at the opening of the new gymnasium last December, and of a lecture on the influence of athletic games on Greek art, by Dr. Waldstein of Cambridge, Eng. Plans are printed of the new chemical laboratory, and announcements are made of a series of fifteen lectures on classical archeology, now just closing, by Dr. Waldstein, Professor Gildersleeve, Dr. Emerson, and Messrs. Clarke and Stillman. A similar related series of sixteen historical lectures on chemistry is in progress, participated in by ten persons.

— A new species of trap-door spider, a species of Cteniza, has been discovered at San José, Cal. The common though little-known species of southern California is known as C. californica; and its trap-door nest is usually placed in museums beside the tarantula (Mygale Hentzii), and erroneously labelled as the tarantula's nest. This popular error, by which dealers in curiosities generally profit, is stranger, since the tarantula is usually too large to enter the nest of Cteniza, and itself makes no nest, occupying crevices in the ground or under stones, spinning a small web.

— The Boston society of natural history announces that the seaside laboratory, at Annisquam, Mass., will be open to students during the coming summer from June 20 to Sept. 1. The purpose of the laboratory is to afford opportunities for the study of the development, anatomy, and habits of common types of marine animals, under suitable direction and advice. There will be no attempt to give lectures nor any stated courses of instruction. Those who have had some experience in a laboratory, who have attended practical lessons, or who have taught in the schools, are sufficiently qualified to make use of this opportunity. The work will be under the immediate care of Mr. J. S. Kingsley during June and July, and Mr. B. H. Van Vleck during August. Applications should be addressed to Professor Alpheus Hyatt, Boston society of natural history.

— Koban is the name of an ancient necropolis in the Caucasus, explored by Chantre in 1882, and said by him to be the most interesting in that region. In 1869 a flood took away a part of the hill of Koban; and the owner, one Kanoukoff, an Ossete, discovered along the portion of the hill left, bones and objects of metal. Finding that they were not gold, he sold them to the museum of Tiflis. For several years this site has been dug by local archeologists; and in 1882 Chantre commenced a systematic exploration. Koban is a little Ossete village, three thousand metres above sea-level, on Tagaour Mountain, thirty-five kilometres distant from Vladikawkaz. The necropolis occupies two hectares. Transverse ditches from one to three metres deep disclosed twenty-two sepultures. Simple inhumation without incineration had been the mode of burial. The coffins were of plank or stone, and were not oriented. The bodies lay doubled up, and on the right side. More than three thousand objects have been recovered, mostly of bronze: of these, Chantre secured sixteen hundred and ninety-seven. The list includes articles of the toilet, arms, and utensils. The origin and the antiquity of these objects are alike unknown, a diversity existing between the contents of this and other cemeteries in the same region. Ethnological comparisons and classical allusions lead to the supposition that the ancient Ossetes came from the Caspian Sea. These people live now in the centre of the Caucasus, in the defiles, more or less rugged, of Mount Kasbeck. There remain only a hundred thousand of them. Those of the north present some resemblances to the Kabardians and Tchitchens, who surround them. Those of

the south borrow from their neighbors, the Georgians, some of their usages.

— *Terramares* is an Italian archeological term, adopted into the French scheme of Mortillet and Chantre with an appropriate symbol. Castione, the most noteworthy of the Italian terramares, is a hillock on a plain in the province of Parma, three metres higher than the surrounding area. Its former inhabitants, aiming to avoid places subject to inundation, halted upon this low plateau of bluish clay, not yet covered with the deposit of alluvium. The space occupied by the village, or settlement, was somewhat rectangular, containing about nine thousand square metres, and was enclosed by a ditch, or basin, oriented, its axis deviating thirty degrees from north to south. The first palafitte constructed over this broad ditch was floored with puncheons covered with calcareous sand, whereon were built huts of wood or straw. Through holes in the floors were thrown ashes, cinders, refuse of all kinds. Of course, when this process had filled up the space beneath, the people had to burn their rude huts, draw up the piles, and commence over again. From the relics found in the terramares, it is possible to derive some notion of the time of their construction, which seems to have had its beginning in the age of stone, and extended through the age of bronze. If it reached the age of iron, it was when the last layer was forming. Pigorini regards unfavorably the opinion that the basins surrounding the terramares were systematically fed by streams of water.

— Whoever studied the Tunis department of our centennial exhibition, saw a large, thick plank, whose under surface was thickly set with teeth of chipped flint. This was the *tribulum* (a Latin word, meaning a threshing-sledge, whence the word 'tribulation'). We are not surprised to see this old threshing-sledge in use in northern Africa. Indeed, it is one of the delightful cases of survival that so often spring upon us. Mr. Léon Didelot has written a chapter on this implement (*Bull. soc. anthrop. Lyon*, ii. 75) in which he not only describes one minutely, but quotes the writings of numerous early writers on the subject.

— The Royal society of New South Wales offers its medal and a money-prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects. 1°. To be sent in not later than Sept. 30, 1884: Origin and mode of occurrence of gold-bearing veins and of the associated minerals, the society's medal and twenty-five pounds; Influence of the Australian climate in producing modifications of diseases, the society's medal and twenty-five pounds; The infusoria peculiar to Australia, the society's medal and twenty-five pounds; The water-supply in the *interior* of New South Wales, the society's medal and twenty-five pounds. 2°. To be sent in not later than May 1, 1885: Anatomy and life-history of Echidna and Platypus, the society's medal and twenty-five pounds; Anatomy and life-history of Mollusca peculiar to Australia, the society's medal and twenty-five pounds; The chemical composition of the products from the so-called kerosene shale of New South Wales, the society's medal and twenty-five pounds. 3°. To be sent in not later than May 1, 1886: The chemistry of the Australian gums and resins, the society's medal and twenty-five pounds. The competition is in no way confined to members of the society, nor to residents in Australia. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor. No award will be made for a mere compilation, however meritorious in its way.

— M. Grunes has published in *La métallurgie* the result of a year's researches on the oxidizability of iron and steel under the influence of moist air, fresh, sea, and acidulated water. The numerous results are in the highest degree instructive. We can only state that iron is dissolved rapidly by sea-water, cast-iron losing about half as much as steel, and that *spiegeleisen* is the most powerfully acted on by sea-water.

— A circular has been issued by a committee of the Mechanical science section of the American association, urging all engineers and others interested to make the meeting of the section at Philadelphia a notable one.

— The programme of observations of the small planets Victoria and Sappho in 1882, for determination of the solar parallax, drawn up by Dr. David Gill, her Majesty's astronomer at the Cape of Good Hope, appears to have met with general favor at the hands of astronomers in different parts of the world. The latest contribution of observations is a series published in No. 2574 of the *Astronomische nachrichten* (band 108), made by Professor Kurt Bohlin at the observatory at Upsala. The observations were begun early in August, 1882, and continued for somewhat more than two months.

— Every member of the group of small planets discovered up to the present time has now a name; No. 233, discovered by Borelly at Marseilles, May 11, 1883, having received the name Asterope. The elements of the orbit of No. 235, Carolina, have been determined by Professor Frisby.

— Dr. Finsch's account of the anthropology of the South-Sea Islands has just been published by Asher of Berlin. Dr. Finsch secured no less than a hundred and sixty-four casts of the faces of the inhabitants from sixty-one different islands: so his facts will not rest on individual observation alone. These casts have been on view at the Berlin 'Panopticum.'

— The use of the dynamo-electric machine for the ventilation of mines is reported from Saxony. At the Carola pits, Messrs. Siemens and Halske, the German electricians, have inaugurated the system. At the pit bank a dynamo is stationed, which is coupled up by shafting with the engine. By means of copper conductors, this machine is connected with another dynamo, two thousand five hundred feet away in the depths of the mine. This latter is connected with a powerful centrifugal fan. The cost of working these combined machines is six shillings and threepence per day, which means threepence for every million cubic feet of air delivered.

SCIENCE.

FRIDAY, APRIL 18, 1884.

COMMENT AND CRITICISM.

TRAVELLERS in the west during the past few years will surely have met the statement that the rainfall of the dry region beyond the Mississippi is increasing. Many western settlers express the hasty conclusion that the change is a steadily progressing one, and is due to the cultivation of the ground; and the more venturesome theorists explain the increase as an effect of the better equalization of electric conditions of the atmosphere, as allowed by the laying of iron rails and the stretching of iron wires across the plains. The natural extension of these theories pictures the plains in the near future redeemed from their present unprofitable dryness by persistent occupation. It is well to set these unwarrantable fancies face to face with the matter-of-fact statistics lately published by the signal-service; for, whatever the doubtful possibilities of man's power may be, the connection of such small artificial changes with variation of rainfall in the relation of cause and effect is in the last degree questionable. There is not the least reason to think that the *régime* of the winds and rain can be permanently affected so easily, or that any progressive change is going on so rapidly as to make itself felt in a decade of years.

As to the fact of variation in rainfall from year to year, there is, of course, no question: this is a most ordinary condition, especially in regions of moderate precipitation, where a good share of the annual fall may be gathered from a single storm. But, beyond this, the tables lately published show certain wide-spread variations of importance. Signal-service note no. vii., prepared by Mr. H. A. Hazen, discusses the variation of rainfall west of the Mississippi River, as shown in the records of nearly seventy stations from 1871 to 1882 inclusive, with the conclusion that "many more years of observation will be needed, as well as many additional stations, . . . before any secular variation can be fully established." The tables show irregularities in the amount of rain roughly conformable over large areas. From 1871 to 1873 there was a general deficiency; about 1875, 1876, 1877, there was corresponding excess; 1878 or 1879 was notably dry again; and from then to 1882 there was a general increase, but not above the previous maximum. It is therefore now altogether premature to regard the variation of rainfall as any thing but what may be, in the present condition of meteorology, properly termed 'accidental;' that is, due to subordinate causes not yet determined, and not to any progressively increasing factor, like cultivation or rail-laying.

"THIS brings them dangerously near the American category of 'dead heads;' but, lest they should incur the additional reproach of being 'free lunchers,' they will be allowed to pay a sum not exceeding two shillings for a 'square meal.'" This, from the comments of the London *Times* on the great American or Canadian promised hospitality to the British association, on its approaching visit to Montreal, has reference to the alluring pictures held up of the trip west on the Canadian Pacific railroad. 'Allowed to pay two shillings' — what a favor! — for a meal in a crowded saloon of a crowded steamer, first table, second table, third table, as the promptness and skill of the traveller in 'jumping' a chair may justify. 'For a square meal' in a tent, two hundred miles from the nearest cow, how gladly the easy-going English traveller will pay his two shillings, — money which would bring a cup, a saucer, a plate, a knife, a fork, in England, but in Canada's backwoods restaurant may only secure a saucer. How happy our English cousin with a saucer, and a blushing rustic before him to inform him that there is bread;

perhaps, to fill it, but no beer, no milk, no good water, only bad tea and bad coffee! A few days of such living, a glance into a 'muskeag,' a ride over the streets of Winnipeg, and how mistaken will appear the managers of the association in planning an American meeting!

The visits of foreign astronomers to observatories on American soil have of late years been very frequent; and it is not, perhaps, too much to say that the impressions they have carried away have in the main been of a pleasantly favorable and in some instances of even a surprising character. Occasionally they have made free to express themselves with regard to the somewhat rapid development of, and the future outlook for, their science in this country; but only infrequently have their opinions and criticisms been placed on permanent record. During the latter part of the summer of 1883, Dr. Ralph Copeland, astronomer to the Earl of Crawford and Balcarres, and editor of the lately discontinued journal *Copernicus*, passed through the United States, and visited a goodly number of the more active observatories, among them those at Cambridge, Washington, Princeton, Albany, and Clinton. His general impressions, as he modestly styles them, are far from uninteresting; and, while there is much that has been suggested before, American astronomy has not yet advanced to a stage where no opportunity offers for advantage from such suggestions.

The decision of our treasury department, by which fine weights, such as are necessarily used by every chemist, are for customs purposes not to be regarded as 'philosophical apparatus,' but as articles worked in metal, is as plain a violation of the spirit of the law as could well be imagined. A similar case presented itself a few years ago, when a college imported bottles for use in the chemical laboratory. There was no doubt about the fact that the bottles were to be used for purely scientific purposes. They were without question 'philosophical apparatus' in the sense in which that expression is used in the tariff law; and yet the secretary decided that the bottles were to be classed as bottles, and not as 'philosophical apparatus;' and the college had to pay duty on them to the extent of forty per cent *ad valorem*. If the law, as it stands, has any object, that object is, by relieving educational institutions from certain burdens, to encourage the spread of knowledge. Without this object, the law is meaningless. By what right, then, does the secretary of the treasury decide that educational institutions shall not have the benefit of the law?

The child, seeing for the first time the evening star, exclaims, 'O mamma! God has made a star.' How should this wondering admiration of the novelties to the opening mind be received? The parent has seen many a star, has possibly a great objection to stars from being obliged to watch them for hours. Next morning the child may rush in with open eyes, and demand the mother's sympathy, in its excitement over a passing wagon heavily loaded, and drawn by six horses; or at the quaint humanism of the organ-grinder's companion at the street-corner. These, again, are familiar experiences to the mother, and of themselves would only call forth a moan at the rumbling of the wheels or at the squeaking of the pipes. The child feels hurt if sent away with only a 'Yes, dear,' or 'Run along,' and next time wonders to itself, and another time not at all. To the teacher and to the editor rushes the boy of all ages, and with trembling voice announces that 'the thickness of a mercury-drop on a glass plate is constant,' and suggests its adoption as a standard of length, or that a rotating wheel resists a change in the plane of its rotation, and immediately builds upon his experiment a perpetual motion, or that he has found some relation between the physical constants of a few bodies, and warps the others to fit some preconceived theory. How is all this enthusiasm to be met? With the child, it is the evidence of an active intellect, and gives promise for the future, and may be enjoyed with it; with the boy of tender age, there is no harm in pointing out that he has

come on the stage at a comparatively late period in the world's activity, and that it would be well to inquire, before bounding with joy at his new possession, whether it may not be an old one in the world's stock of knowledge, or even valueless; but for the old boy, the incorrigible old boy, who is constantly popping up with his theory of comets, his theory of the gyroscope, or his very important measurements of the thickness of a mercury-drop, what can be done? His questions and talk may show evidences of an active mind, but of a mind working within a Chinese wall of self-sufficiency. He feels intensely indignant when told to examine the records, and compare his work with that of others. He is only working as every philosopher formerly worked, within himself; but at this age he is — a bore.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The use of the method of rates in mathematical teaching.

IN *Science* for March 28, Professor Wood, referring to the method of rates, says, "There is the same difficulty in the fundamental conception as in the infinitesimal method;" and he represents a student as asking the questions, "'In a mathematically perfect engine, does the piston stop at the end of the stroke?' 'Does it remain at rest at any time?' 'How can it reverse its motion, if it does not stop?' 'How can it cease going in one direction, and move in the opposite direction, without stopping between the two motions?'" This difficulty, if it exists, must be met in the teaching of mechanics, and may therefore be discussed apart from the question whether it be advisable to found the differential calculus upon the conception of velocity. The form of the questions which Professor Wood puts into the mouth of the student somewhat puzzles me. I can but suppose that Professor Wood answers 'Yes' to the first question; but, in that case, how can the student ask the third or fourth question? The difficulty must lie in the answer to the second question, 'Does it remain at rest at any time?' It would not be safe to answer this question at all in this form, because it indicates a confusion of mind in the use of the word 'time.' 'At any time' might mean 'at any instant;' but the use of the word 'remain' shows that the student probably meant 'remain at rest *for* any time;' that is, for any interval of time. To the question thus amended, we can safely answer, 'No.' But having already admitted that the piston does stop at a certain instant, namely, 'the end of the stroke,' the student has no occasion to ask the third or fourth question. Of course, a student may be easily puzzled by the metaphysical subtleties and sophistries by which a certain school of philosophy persuaded itself that motion was impossible; but, left to himself, he has no more difficulty in appreciating the difference between an 'instant' and an 'interval' of time than he has in distinguishing between a point and a line in geometry.

Farther on in his letter, Professor Wood asks, 'Does change in the rate of motion take place *at* an instant, or *during* an instant?' It seems to me that if he will dispense with the colloquial use of the word 'instant' for a small interval of time, and substitute 'during an interval,' the so-called difficulty will disappear. Do his students ever ask whether the positive and negative parts of the axis of x are separated by a point, or by a space?

WM. WOOLSEY JOHNSON.

Annapolis, April 5.

Paleozoic high tides.

Your reviewer of the *Geographisches jahrbuch*, referred to by Professor Newberry in *Science* (No. 61, p. 402), was led, by the evidence given in brief below, to the conclusion that tides higher than those now observed, produced in the way explained by G. H. Darwin and illustrated by Ball, had occurred within paleozoic time. It was not, however, his intention to accept the gigantic tides described by Ball, but simply tides *significantly* stronger than those of the present time; for these seem not only warranted, but required, by the spread of paleozoic strata.

Soundings and dredgings, as summarized, for example, in the *Lithologie du fond des mers*, by Delesse, prove that the coarser land-derived sediments, such as form conglomerates and sandstones, are deposited within a moderate distance of their origin, excepting in narrow tide-ways, such as the English Channel, where they stretch out farther; elsewhere, pebbles especially fall within a very narrow fringe along shore. The paleozoic strata of the eastern United States give ample evidence of submarine transportation of land-derived sediments certainly three hundred miles from their source, of sands at least half this distance, and of clean sands with pebbles certainly a hundred miles; and this when measuring only from the present south-western margin of the Cambrian strata. In this regard, the Medina, Oriskany, and carboniferous sandstones and conglomerates, which overlie calcareous or shaly strata, from which their siliceous elements could not have been derived, give very much stronger evidence than that obtained from the Potsdam sandstone, which was formed during the advance of the sea over an old land-surface, whose local waste may have formed this basal deposit close along shore. I must consequently persist in believing that the spread of pebbles and sand over the old sea-floor during the above-named epochs implies a greater transporting-force than is now known in the modern oceans.

The Jurassic sandstones of the Colorado plateau were, according to Capt. Dutton, deposited with very little shaly admixture over an area of thirty-five thousand square miles. A liberal estimate of the Bay of Fundy gives it under four thousand square miles, and its deposits are rather muddy than sandy; that is, muds such as were washed out of the old Jurassic basin are allowed to accumulate in the Bay of Fundy. Whether the tides were much stronger in Jurassic time than now, is perhaps an open question; but that marine transportation was then stronger seems, at least from this example, very probable.

In looking for a cause of former greater activity in the ocean, we find it only in the possible variation of the tides and currents, unless recourse be had to the older cataclysmic theories. Increase in the velocity of currents needs stronger differences between polar and equatorial temperatures, or an advantageous con-

figuration of shores. Our paleozoic ocean was too broad to hurry its currents by crowding them. There is no probability that differences of *ocean* temperature in the past have been great enough seriously to increase the currents; and the little that is known of past aerial temperatures is not enough to insure steeper barometric gradients for stronger winds. As to the velocity of the winds being proportional to the rotation or size of their planet, I must venture to differ from Mr. Darwin (*Nature*, xxv. 1882, 213): for barometric gradients would be steeper on a small planet than on a large one; and the deflecting force, coming from the planet's rotation, depends, not on its size, but on its angular velocity. Moreover, this force does not significantly affect the wind's velocity, but only its direction; and if the earth turned faster, as it may have formerly, the course of the trade winds would be *flattened* (made more oblique to the meridians), but their velocity would not be materially changed, as has been shown by Ferrel. It does not, therefore, seem safe to count on stronger ocean-currents in the past, until it can be shown that the difference between polar and equatorial temperatures was formerly greater than it now is.

But with tides the case is different. There has been found a mechanism by which the tides have decreased automatically from a former greater strength, and I feel that such a contribution to former greater activity in the ocean is to be welcomed in physical geology. It is not a question of six hundred foot tides, by whose devastating strength Mr. Ball has weakened his argument, but of paleozoic marine transportation along the open shores of the ocean, of greater force than is now found; and to this end the old tides promise effective aid. W. M. DAVIS.

Cambridge, April 8.

Transmission of long or inaudible sound-waves.

A simple method of testing whether the atmospheric wave (which, it is claimed, passed around the earth in less than thirty-six hours) had its origin at, and was due to an explosion of, the volcano Krakatoa, would be to examine the previous records of the self-recording instruments for those particular times at which the waves caused by the explosions of some of the larger powder-mines would reach a given locality.

That explosions of this kind cause disturbances which are made manifest (without the aid of any delicate instruments) at localities many miles from the place of disaster is a well-known fact. S.

Tornado in western North Carolina.

On Tuesday, March 25, about five P.M., a tornado passed through portions of Catawba and Iredell counties, extending in a due east course for twenty-five miles.

The first evidence of a destructive storm is two miles and three-fourths west of the town of Newton, the highest point of land east of Baker's Ridge, which is twelve miles to the west. The fallen trees showed two distinct currents of wind, — the one from a few degrees north of west, the other south-west. No evidence of a rotary motion was observed until within three-fourths of a mile of Newton, which, however, was only in a limited area. In the town, and east of it, the rotary motion was decided and destructive.

A very extended and severe hail-storm extended all along the track of the tornado on the north or left side, slowly moving south, reaching the path of the storm. The day had been unusually warm; wind south, shifting to south-west. Several persons witnessed the meeting of the rapidly moving clouds from the south-west with the hail-cloud; also the formation of the descending tornado-cloud. Before it reached the earth, portions became detached, and descended to the earth, afterwards united, and moved forward unbroken. While passing through Newton, the form of the cloud was that of an hourglass, the lower end considerably retarded, the middle portion waving. Immediately east of the town there is a valley; and, when the cloud passed over it, it became erect and funnel-shaped. The surface of the country over which the storm passed is quite diversified. Valleys nearly in the direction of the storm's path were able to deflect its course slightly. The highest points showed evidence of greatest force, though frequently the trees were felled in the lowest parts of the valleys.

The after-wind was but slight. Several houses were lifted from the lower floor and carried away, leaving the occupants unhurt, and not blown along by an after-wind.

The left side of the track is quite sharply defined, while the right extends to a much greater distance, and gradually all trace disappears. The width of the path is from five hundred yards to a mile, though the more destructive part is from a hundred and fifty to five hundred yards.

The damage to houses, barns, timber, and fencing, was very great; nothing being able to withstand the force of the storm except the small trees.

J. W. GORE.

University of North Carolina,
April 8.

Osteology of the cormorant.

If Dr. Gill had read the literature on the cormorant before writing to *Science*, he would have learned that I was following Selenka, and that my reference was all-sufficient for the purpose; namely, a reference to a previous figure. Dr. Gill might as easily have referred the committee to the other references found in Carus and Engelmann's *Bibliotheca zoologica*. Those interested in the subject will find my last remarks on the point in dispute in the *Auk* for April.

J. AMORY JEFFRIES.

The remarks of Dr. Gill, which are contained in his letter to *Science*, No. 61, have just been read by me. As one of the persons designated by your correspondent, permit me to thank him for the information he has so timely tendered.

A certain amount of reprehension always attaches to a laborer in any field of science if he is found not to be thoroughly acquainted with the literature of his subject. This censure is well deserved, particularly if no good excuse exists for such ignorance. The language used by Dr. Gill in his letter seems to bear with it this charge; and, in simple justice to myself, I feel that a few words are demanded from me in answer to it. In my first paper upon the 'Osteology of the cormorant' (ii. 640), I distinctly said that the occipital style is alluded to by Professor Owen, in his 'Anatomy of vertebrates.' That was equivalent to stating the fact that it was universally known to anatomists. The libraries were not available at the time that that article was penned, and I candidly stated in it my ignorance of any figures of the bone in question.

At the time my second notice of this bone was written, the views of other scientific men and the libraries were available; and in a few lines I simply refuted Mr. Jeffries' notion that it was an ossified tendon (ii. 822). Nothing further than this was called

for. In my third and last notice (iii. 143) the manner in which the muscles attached to the occipital style are inserted was alluded to, and it was compared with an ossified ligamentum nuchal. All of this I still maintain. At that time, for lack of material, I had not especially looked into its physiology; and my discussion with Mr. Jeffries closed (Feb. 8, 1884). Since, both through my reading and observation, much has come to my notice of interest with regard to it. Garrod's dissections of Plotus anhinga are very suggestive. Dr. Gill had kindly called my attention to Yarrell's paper, before his notice in *Science* appeared, which he had unexpectedly come across while searching for facts to illustrate another subject. Finally, in one of the most useful and reliable of books, Coues' 'Ornithological bibliography,' I had noticed Rudolphi's article; but other matters were engaging my attention then, and reference was not made to it. There are still others. I have already cited Eyton's figure (iii. 143), and believe, at the time Dr. Gill's review of my work appeared, I was hardly entitled to the charge he brings against me in it. I am more and more convinced, every day of my life, that *good illustrations* of such common facts in anatomy are most urgently demanded. R. W. Shufeldt.

A singular optical phenomenon.

I think it would well repay almost any one to study the beautiful phenomenon so clearly described by 'F. J. S.' (*Science*, No. 57, p. 275), and so suggestively discussed by Professor LeConte (No. 61, p. 404). My own theory of it involves no inverting action, as in the camera, and no *primary* dependence upon binocular vision, but, rather, it resembles the theory of watered silks, or of chords and beats in music. It seems to me geometrically demonstrable; and it includes the phantom meshes' gigantic size, their bewildering motions, their conspicuousness even to eyes out of focus for the actual wires, and the non-appearance in them of objects attached to those wires.

Before the observer are two parallel screens of square-meshed wire netting. The coarser one is seen through the finer, and *the two are at distances from him nearly proportional to the diameters of their meshes, measured from centre to centre of the wires.* To fix the ideas, suppose that he looks with only one eye, seeing the nearer wires black and the farther ones bright: then, if the above proportionality be exact, all the bright wires can be simultaneously eclipsed, each by a separate dark wire; or, upon moving the eye very slightly to the right and upward, all the bright wires will flash into view at once. Now let the observer advance or retire a few inches from this first position, so that the dark wires may subtend visual angles a little larger or smaller than do the corresponding bright ones: several successive bright wires will thus be in view, then one or more will be eclipsed, then several others will be seen, and so on; that is, the phantom screen will be formed, with its great square meshes and shadowy bars.

Next let the observer move slightly to the right: the phantom also moves, but more, and to the right or the left, according as he is in front of or behind his first position. Indeed, the motions of the phantom bars, and the visual angles they subtend, are as if the observer viewed a virtual image whose plane passed through his first position, but imagined it to be some feet in front of him. The size of the virtual image would be very nearly such, that, in it and the farther screen together, there would be as many bars to the foot as in the nearer screen. Its colors would appear to be those of the farther screen, but weaker and oppositely arranged. It would *not* be upside down. Indeed, if 'F. J. S.' will paint the upper wires of the farther screen vermilion, or will hang behind them a blue curtain, then I think that the upper meshes, but not the bars, of the phantom, will be reddened; or the upper bars, and more slightly the meshes, of the phantom, will be bluish. Or, if he will paint the vertical wires red and the horizontal wires yellow, probably the phantom meshes will incline to orange, the vertical phantom bars to yellow, and the horizontal ones to red.

Suppose that two-thirds of the light coming from within the boundary of the farther screen be from the bright wires: then the phantom meshes will be three times as bright as the phantom bars; but at their edges they may blend into one another, the eclipses there being less complete. Thus no lines appear in the phantom whose pictures on the retina are not much broader than the picture of a point, even when out of focus, and hence the phantom is seen by near-sighted and far-sighted alike.

Phantoms often less simple and conspicuous may be got when the visual angles subtended by single spaces in the two screens are not approximately equal, but are approximately in a simple numerical ratio. The screens may also be of lattice-work, or pale fences, not necessarily parallel, seen two or three deep against the sky; and the effects are sometimes very beautiful.

Undoubtedly, when the screens are fine, binocular vision, with the stereoscopic matching of patterns, comes in, as suggested by Professor LeConte; making the phantom seem real and solid, and fixing its assumed distance from the observer. But I leave this part of the discussion to him, because he can treat it far better than I can. James Edward Oliver.

Cornell university, April 8.

I was gratified to find that the phenomenon described in No. 57 proved of interest to Professor Joseph LeConte. He states that my explanation of the cause of the phenomenon is erroneous, and I am in no wise qualified to dispute him. Nevertheless, a careful repetition of the experiment would indicate that his explanation is not the correct one. The phantom image is as readily seen with one eye as with two; and I still think I am correct in saying it is inverted and magnified. I hope Professor LeConte will make the experiment himself, and give us his explanation of the phenomenon. In the mean time, allow me to state the facts as they occurred in an experiment made after reading his letter.

Standing about twelve feet from an ordinary fly-screen, and looking through it at the blinds of a house about one hundred and fifty feet distant, phantom lines, alternately a light one and a dark one, are seen crossing so much of the field of view in which the blinds lie, but not continued beyond their limits. The lines remain visible, although one eye be closed.

The image rises as I bow my head, and sinks as I lift it. Is not this evidence of inversion?

I can readily count the lines that lie across a blind, twelve light and twelve dark ones; but, in order to correctly count the actual slats in the blind, I am obliged, on account of the distance, to have recourse to a telescope. My wife, who is short-sighted, can only distinguish the mere outline of the actual blind; but the phantom lines are plainly visible to her. The number of slats in a blind is thirty, which would give sixty alternating dark and light lines. Is not this evidence of magnification? F. J. S.

ANDREW ATKINSON HUMPHREYS.

AMERICAN science is again called to mourn the loss of one of its leaders, the friend and colleague of Bache and Henry. With him, as with them, administrative duties restricted and hampered individual investigation; but he was able to accomplish enough in this field for lasting fame.

Andrew Atkinson Humphreys was born in Philadelphia on Nov. 2, 1810. His family was one of the oldest and most distinguished of Pennsylvania, represented in the first continental congress, and eminent for two generations in the corps of naval constructors. To the skill of his grandfather were due the designs on which were built the famous Constitution and her five sister-frigates, which carried the flag of the Republic so proudly in the war of 1812.

When between sixteen and seventeen years of age, the boy entered the military academy at West Point, then almost the only mathematical and scientific school in the country. He was graduated in 1831, in the same class with Henry Clay, jun., who fell so gallantly in the battle of Buena Vista; Professor Norton, late of Yale college; and several others eminent both in war and in peace. He first served in Florida as an officer in the second artillery; but the climate so affected his health, that in 1836 he was forced to resign his commission.

Two years later the corps of topographical engineers was re-organized as a distinct branch of the army, and Humphreys was appointed one of the first lieutenants. Among his earlier duties was to prepare a plan for extending and remodelling the Capitol at Washington; and his design, in many of its features, was finally adopted.

In 1844 he was assigned to the charge of the coast-survey office, under Professor Bache as superintendent; and for five years he labored most assiduously and successfully to perfect the organization of this institution. His assistance was appreciated by his chief, who always remained a warm personal friend.

In 1850 Capt. Humphreys was charged with the surveys and investigations, then inaugurated, to determine the best method of restraining the floods of the Mississippi River, and of deepening the channels at the mouths. This work continued for ten years, and, even if he had done nothing else for science, would have placed him at the head of his profession. The hydraulics of rivers have been studied by eminent physicists for hundreds of years: but it may safely be asserted that none among them displayed more skill in conducting investigations, or more ability in discussing results; while the size of the river, and the thoroughness with which the work was executed, were without precedent in any former operations of like character.

But this labor represented only a small part of the professional burden resting on Capt. Humphreys during those ten years of his life. He was also charged (1854) with the direction of the surveys for selecting the best railroad-route from the Mississippi River to the Pacific Ocean, and with discussing and analyzing the results, — a work which he accomplished in a manner scarcely less admirable than that upon the Mississippi. He was also an active member of the Light-house board and of several important commissions. Indeed, it seemed to those associated with him that there was no limit to the demands to be made upon him, or to his ability to meet them. His health suffered from his intense application, but was quite restored during the war.

Gen. Humphreys' military services need not be recounted here. They were of a distinguished character, especially after Gettysburg. From that date he was either chief of staff of the Army of the Potomac, or in command of one of its army corps; and his brilliant reputation as a scientific man was equalled by that acquired as a soldier.

Shortly after the war he was called to the chief command of the corps of engineers and of the engineer department, with the rank of brigadier-general; and for thirteen years he filled this responsible position in a manner to win the respect of every one thrown in contact with him. In 1879 his name was placed upon the retired list of the army at his own request.

With such a record, and at the age of over threescore years and ten, most persons would be content to rest on their laurels. Not so was Gen. Humphreys. His connection with the Army of the Potomac had been of a character to render him, of all men, the most fit to write its history. He undertook the task for the period after Gettysburg; and in two volumes of the 'Campaigns of the civil war,' published by Scribner, he has left a military classic which will form the basis of future history. It is to be regretted that the limits as to size, of this publication, rendered a degree of condensation necessary which has marred the work for any but a professional reader.

Gen. Humphreys' individual contributions to science, and his care to advance its interests,

were appreciated. In 1857 he was elected a member of the American philosophical society; in 1862, an honorary member of the Imperial royal geological institute of Vienna; in 1863, a fellow of the American academy of arts and sciences. In the same year his name was placed on the list of the original corporators of the National academy of sciences. In 1864 he was elected an honorary member of the Royal institute of science and arts of Lombardy, Milan. He was also a corresponding member of the Geographical society of Paris, of the Austrian society of engineer architects, and of the New Orleans academy of sciences. In 1880 he was elected an honorary member of the Italian geological society. The degree of LL.D. was conferred upon him by Harvard college in 1868.

In the regular service, beside the ordinary promotion in his corps, he received the brevets of colonel, brigadier-general, and major-general, for gallant and meritorious services in the battles of Fredericksburg, Gettysburg, and Sailor's Creek.

Gen. Humphreys' death occurred at his home on the evening of Dec. 27, 1883. He passed away when reading at his table, shortly after being left, apparently in good health, by the family. The manner was what the soldier himself would have chosen.

It is difficult, in referring to the personal character of Gen. Humphreys, to avoid seeming exaggeration. He united to all the manly virtues the delicacy and refinement of the weaker sex. Any thing mean, cowardly, or Jesuitical excited his indignation; and the higher the position of the culprit, the more certain and violent the explosion. He was generous in the highest sense of the word, and slow to suspect evil. His mind was analytical, original, and inventive. His intuitive perceptions were of surprising accuracy, but he held his judgment in reserve until the evidence was presented and weighed; then he took his position, and could not be moved. It was impossible to be thrown into intimate relations with him without being impressed with his strength, and charmed with his lovable character.

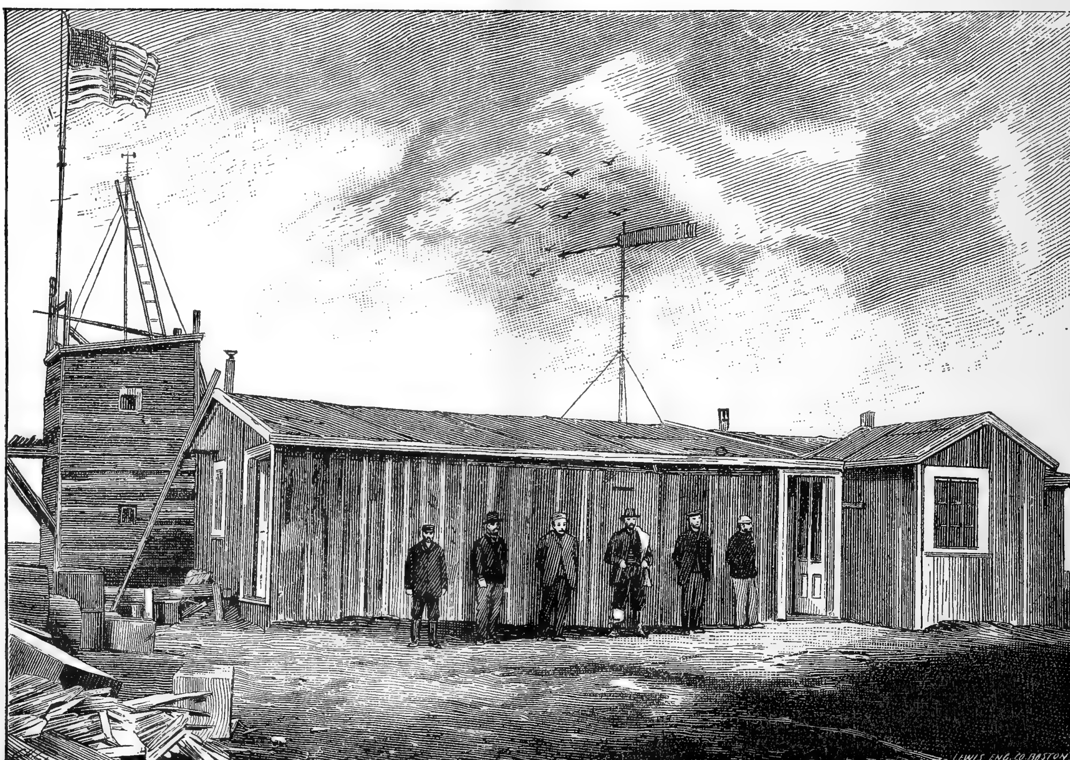
HENRY L. ABBOT.

THE U. S. METEOROLOGICAL STATION AT POINT BARROW.[1]

THE U. S. expedition to Point Barrow, Alaska, sent out under the auspices of the Signal-service in 1881, was one of the International polar expeditions determined upon by the International polar congress, which met in Hamburg in October, 1879, and was designed to co-operate with the various stations established around the north pole in simultaneous observations in the three elements of magnetism and in meteorology. Nearly the whole civilized world was represented in this work; and, commencing with the Greely party at Lady Franklin Bay, they posted their chain of videttes around the pole in the following order: Denmark, Upernavik and Godthaab; Germany, Pendulum Island; Austria, Iceland and the Island of Jan Mayen; Sweden, Mosel Bay, on Holland, Dickson Haven; United States, Point Barrow and Lady Franklin Bay. The series of international observations proper was to commence Aug. 1, 1882, and end Aug. 31, 1883.

The little colony for Point Barrow, consisting of ten persons in all, sailed from San Francisco, Cal., in the schooner Golden Fleece, on the 18th of July, 1881, and, after a long, monotonous voyage across the North Pacific, passed into Bering Sea, through the Unimak Pass, on the 15th of August, and after touching at Plover Bay, Siberia, to correct the rate of their chronometers by observation on that well-established meridian, passed through Bering's Strait on the twenty-seventh day of August, and reached their destination on the 8th of September, fifty-one days out from San Francisco. The vessel returned to the United States at once, after discharging her cargo.

The energies of the party were at first en-

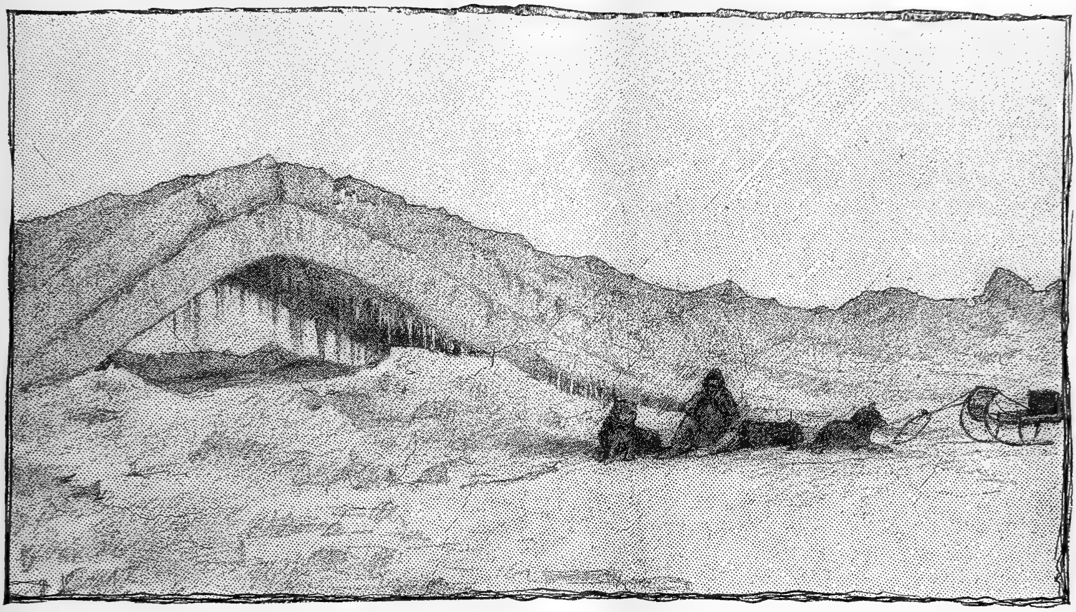


SIGNAL-STATION AT POINT BARROW, ALASKA UNITED-STATES.

West Spitzbergen; Norway, Bossekop; Finland, Sodankyla; Russia, Moller Bay, on Spitzbergen, and at the mouth of the Lena; tirely devoted to housing themselves for the winter, and securing their stores; and the 1st of October found them with the building nearly completed, observatories up, and with three years' supplies well secured, in a condition to

[1] Communicated by permission of Gen. W. B. Hazen, chief signal-officer.

look the future very confidently in the face. The instruments were placed, and hourly observations in meteorology commenced, on Oct. 17, and in magnetism on Dec. 1; and this work was carried on without a single interruption from that time up to the last hour the station was occupied, on the twenty-ninth day of August, 1883. In addition to the prescribed meteorological observations, the work was extended to taking and recording the temperature of the sea-water, top and bottom, the sea-ice, and the earth, and measuring the terrestrial and solar radiation.



ICE-ARCH FORMED NEAR POINT BARROW.

The auroral display of this region was grand beyond all description; and nearly every unclouded night from September to May was lit up with the dancing light of this strange phenomenon; and, when shut from our view by the clouds, the disturbed needle told of its presence.

The tidal record shows that the adjacent ocean is almost tideless; and that there is no influx of warm water from the Japan current or elsewhere was shown in the even temperature of the sea-water at all depths, from October to June.

The earth was found to be frozen to an immense depth. The temperature at thirty-eight feet (the lowest depth attained) was + 12° F., and the ratio of increase of temperature for that distance gives the depth of the frost to be nearly three hundred feet. At the lower depths attained, the temperature never changes; and at the depth of twenty-six feet, which was fourteen feet below the sea-level, was found a pair of wooden snow-goggles of the same pattern as those worn now, showing that this region has been inhabited by man for a longer period than has generally been supposed by ethnologists. The peculiar race inhabiting this region would seem to be indigenous to the ice period in all latitudes.

After November we found that all animal life disappears from the land; and, except for an occasional stray reindeer or white fox, we saw no living thing but the Innuit and his dog from November until May, and the sea gave us only the arctic cod and small hair seal (Phoca foetida).

Lying between us and the pole was a sea of eternal ice, which we believe is an impassable barrier between us and latitude 90° north: over its rough and broken surface it is impossible to travel with any known means of transportation. Unencumbered and on foot is the only manner in which man can penetrate this unknown world: so the distance he can travel is limited to the number of days he can carry supplies on his back, or by the slow process of floating; and nature is ever crowding him back, even where the current sets to the north in her process of restoring her equilibrium at the pole. We found from long, careful observations, that the maximum thickness of sea-ice over still

water was about seven feet; but, owing to the influence of gales and currents, the whole ocean is filled with pack from fifty to two hundred feet in thickness. During the whole winter this region is subject to violent local gales, which open huge cracks in this frozen ocean, often extending many miles, and from ten to five hundred yards wide. These cracks freeze over very rapidly, as the temperature of the sea-water alway stands at 29.2° F. We have known two feet and a half of ice to be formed over one of these cracks in ten hours. This expansion, acting like a great wedge, shoves the great masses of pack apart; and it can only find room in the direction of the lower latitudes, or side of the least resistance. Hence we see along the southern edge of the eternal pack a continual crowding-down of old ice, which has yielded to the new ice formed in the cracks, and, in its turn, is packed and displaced; but we never found that there was any accumulation of new ice on the submerged masses of old pack, no matter to what depth they rested in the water. This process going on daily and hourly, the ice over the pole is kept at an even thickness; the old, heavy ice, often high above the surface, yielding to the new. We never found that ice formed on the bottom of the sea, the lakes, or the rivers.

The migration of the eider occurs in May; and the flight is to the north-east, in the direction of Prince Patrick's Land. We never saw any flight of birds to or from true north at any season of the year. They commence returning along the western shore in July, and linger as long as there is any open water.

The members of the expedition found time to make a large collection in ethnology and natural history, which has been turned over to the Smithsonian institution, and is now being catalogued and placed. All records were kept in duplicate, and both copies were brought safely back to the United States. The official report is now being compiled at Washington, and will be issued by the signal-office as soon as published.

The party returned to the United States on the schooner Leo, chartered for that purpose; leaving the station Aug. 29, 1883, and returned *viâ* Bering Strait and the Pass of Akutan, landing at San Francisco, Cal., Oct. 7, 1883; touching only at St. Michael's, where Lieut. Schwatka and his party were found waiting for a chance to return to the United States, after their adventurous ride of over two thousand miles down the Yukon on a raft, and at Unalaska, to repair our little vessel, which had been damaged by the ice. P. H. RAY.

ON THE STATE OF THE INTERIOR OF THE EARTH.

THE appearance of the new edition of Thomson and Tait's treatise on natural philosophy affords an opportunity for geologists to object to conclusions reached by physicists in relation to the condition of the interior of the earth. Various physicists, chief among whom are Hopkins, Sir William Thomson, and G. H. Darwin, have concluded, from a discussion of the phenomena of precession and of tidal friction, that the earth is a solid, with a rigidity at least as great as steel. Some time ago Thomson retracted the first part of the argument, on a suggestion made by Newcomb, and the writer expected to see a retraction of the entire argument in the new edition of the philosophy; but it does not appear. Yet the statement is somewhat modified. On the 485th page of vol. i., part ii., the following paragraph appears: —

"These conclusions, drawn solely from a consideration of the necessary order of cooling and consolidation, according to Bischof's result as to the relative specific gravities of solid and of melted rock, are in perfect accordance with §§ 832–848, regarding the present condition of the earth's interior, — that it is not, as commonly supposed, all liquid within a thin solid crust of from 30 to 100 miles thick, but that it is, on the whole, more rigid, certainly, than a continuous solid globe of glass of the same diameter, and probably than one of steel."

It is not my purpose as a geologist to discuss the methods by which this conclusion is reached; nor shall I array the facts by which geologists arrive at a different conclusion. I propose simply to characterize the lines of inductive reasoning used by them. These are as follows: —

I. The argument from displacement.

The writer has carefully studied a fault in Utah and Arizona, about three hundred miles in length, with a throw varying from two thousand to five thousand feet. Everywhere along its course the displacement is easily seen: its verity is a fact of observation, confirmed by the observation of other geologists thoroughly competent. The fault is so plain, that the tyro in geology may see it. Now, in the case of this fault, three hypotheses may be entertained, — first, that the thrown side subsided; second, that the thrown side remained stationary in relation to the centre of the earth, and the opposite side was upheaved; or, third, that

while the thrown side went down, the opposite side went up. To explain the first hypothesis, we must have either a condensation of the mass underlying the thrown side, extending toward the centre of the earth, or a transferrence of the material from immediately beneath the thrown side to some other part of the interior of the earth. A condensation or a transference is absolutely necessary. The latter hypothesis is the hypothesis of a fluid interior. In the second case mentioned above, where the side opposite the thrown block is supposed to be upheaved, there must be either an expansion of the immediately underlying material, or a transferrence of material. The hypothesis of a vacuum beneath is untenable, for it can be easily demonstrated that the strength of materials could not possibly sustain the resultant stress. We are forced, therefore, to the conclusion that there is either an expansion or a transferrence of material, the latter being equivalent to the hypothesis of an interior fluid. The third case is, that one side went down while the other side went up; and this hypothesis is sustained by many concomitant facts. In this case there must either be a condensation on one side and an expansion on the other, or a transferrence of material: and geologists conclude that there has been a transferrence of material; i.e., they postulate a fluid interior.

Faults like the one above mentioned are not infrequent. Many are discovered of greater magnitude, many more of less; and, wherever the geology of any great district of country has been explored, such faults have been discovered, so that they are now known to exist in great numbers throughout all the studied portion of the land-surface of the earth. Every year's research — it may almost be said every month's or every week's research — adds to the number.

In addition to these faults, geologists are everywhere discovering flexures, many of them simple monoclinal bendings by which the crust of the earth is displaced; one side being lowered, or the other raised, or the two simultaneously moved. Again: great anticlinal flexures are discovered, sometimes developed to appressed folds, and monoclinal and anticlinal flexures are found throughout the whole known portion of the land-surface of the earth; so that these displacements by faulting and by flexure are widely and generally distributed.

Again: displacement is a phenomenon, not simply of the present time, but of all known geologic time; as like displacements are discovered of various ages, beginning with the oldest archaean, and extending to the present time. Nor can we say that displacement was either greater or less in earlier geologic times than in the present. Such displacements as have been here briefly characterized have occurred again and again in the same district of country, sometimes following the old lines, oftener along new lines, traversing in diverse ways the same territory; so that blocks of the crust that have at one time been upheaved have at another time subsided, and blocks that at one time have subsided have at another been upheaved. It is sometimes possible to discover as many as six or more epochs of alternating displacement; in the first the rocks going up, in the second down, then up, then down, etc. The evidence of repeated displacement in the same district is not simply local, but is widely spread throughout the known portion of the land-surface of the earth.

But the evidence for a fluid condition of the interior, derived from displacement, does not end here. Take first a simple example like the following: a block of stony crust is separated from the adjacent rock on all sides by fracture. Such a block may be many miles in length (ten or a hundred), and of varying width (two or twenty miles). Such a severed block will be found by the geologist to have careened, one side or edge going down while the other came up. In order to explain this displacement, it is necessary to assume that there was an increasing rate of expansion beneath the block from the axis of rotation to the upturned edge, and an increasing condensation of the underlying material from the same axis to the edge of the down-thrown side, or to assume that it careened on a fluid mass. The latter is the explanation accepted by geologists. Again: such a block may be broken into many parts, each one of which behaves as an integer, and careens on its own axis. Many such careened blocks have been discovered, though this particular form of displacement has not been described by geologists to the extent of those mentioned above.

II. *The argument from vulcanism.*

Fluid matter comes up from unknown depths, and is sometimes intercalated between horizontal or dipping beds of sedimentary rock; but oftener it comes to the surface and is poured out in sheets, sheet being piled on sheet until mountains and mountain systems are produced. The amount of matter thus brought up from below is great; and it occupies large

areas throughout all the known portion of the earth, forming the substance of many mesas, plateaus, and mountain systems, in which valleys and valley systems are carved. The pouring-out of this volcanic matter is not confined to the present time, or to late geologic time. Nor can the geologist assert that the rate of extravasation has increased or diminished from the earliest known geologic time to the present. It seems to have been paroxysmal by districts, but uniform, considering the whole extent of the surface of the earth. The magnitude of the volcanic formations exposed at the surface is such that the origin of the material cannot be attributed to local and trivial causes: it must be explained by laws of universal application. Extravasation is always associated, so far as the phenomena have been studied, with displacement; and this association is of such a nature that they must have a common explanation. This common explanation, as postulated by geologists, is a fluid interior.

III. The argument from internal temperature.

The hypothesis of a fluid interior is reached by another inductive method, — through the facts relating to increase of temperature from the surface downward. The rate of increase is not well known; it seems to be greatly variable. In general, it may be roughly stated, as it is by Thomson and Tait, as about one degree for each fifty feet; but in many cases the rate is much higher. Such an increase, known to extend so far down as observation and experiment have reached, if continued at the same rate, would soon give a temperature at which all known rocks would be melted; and the hypothesis of a fluid condition is thereby strengthened.

IV. The argument from the 'flow of solids.'

It is an hypothesis worthy of consideration, that pressure itself would reduce the interior of the earth to a fluid condition. That rigidity, which is the characteristic of the solid state, is due to molecular cohesion; but geologists everywhere in their researches discover that this molecular cohesion, or rigidity, may be overcome by pressure: for everywhere they find that rocks may be squeezed into new forms, bent, contorted, and implicated; that is, the force of compression existing in many thousands of feet of superincumbent rock overcomes molecular cohesion to such an extent as to cause rocks to yield (the molecular cohesion is broken down). Doubtless the element of time is involved, to some extent, as a rock may be bent with a small force, if sufficient time be allowed. But with increase of force there may be decrease of time; and the force engaged in compression, being the weight of miles of superincumbent rock, must be sufficient to greatly reduce the element of time, and perhaps to cause it to disappear. The last few years of experiment have added to the argument derived from geologic observation. Many solids have already been found to flow under pressure. The molecular constitution of solids is found to undergo a change by reason of pressure, so that new compounds may be formed thereby; and in pressure we have conditions for chemical change analogous to the conditions produced by melting. It is therefore an inductive hypothesis of the highest value, that all rocks may be reduced to a fluid condition — i.e., be caused to behave as bodies of minute parts, without rigidity of structure — by pressure alone.

The facts of observation and experiment characterized above are vastly multifarious and cumulative, and the conclusions in each case are strictly inductive. The theory reached by the consilience of these four inductive processes is so strong, that structural geologists are compelled to accept it, and contradictory conclusions are rejected. It therefore behooves the physicist to re-examine his data and his methods of logical procedure; for, perchance, he may discover that an error lurks therein.

J. W. POWELL.

INERTIA.

RECENT conversations with teachers of physics have shown me that there exists, in this country at least, great diversity of opinion as to the proper definition and use of the term 'inertia.'

Elementary text-books usually speak of inertia as a mere *inability*, — the inability of a body to set itself in motion, or to stop itself when once in motion. This is an old use of the term, but certainly not the best use. Maxwell states,[1] that at the revival of science, "while the men of science understood by this term [the inertia of matter] the tendency of the body to persevere in its state of motion (or rest), and considered it a *measurable quantity* [the Italics are mine], those philosophers who were unacquainted with science understood inertia in its literal sense as a quality — mere want of activity, or laziness."

Maxwell suggests certain simple experiments

[1] Theory of heat, p. 86.

which the student may perform in order to become thoroughly acquainted with that property of matter which he calls inertia. I shall describe an additional experiment, for I find that the difficulty is not merely one of words. There are many people who do not recognize the physical facts to be dealt with.

Take a heavy weight, fifty pounds let us say, and suspend it by a long cord. To the weight thus hanging attach another cord, strong enough to sustain the fifty pounds. By means of this latter cord give a sharp horizontal pull to the weight. The cord is broken, while the weight hardly moves, — is left slightly swinging. Is it possible for any one to try this experiment, and not recognize that we have to do here with something more than the inability of matter to set itself in motion? Evidently we encountered a *resistance* in setting the body in motion. Whence came that resistance? Not from gravity: the pull was horizontal; and, moreover, the cord we have broken would have served to lift the weight. Assuredly not from friction, or resistance of the air. We are driven to the conclusion that matter possesses a property in virtue of which it *offers resistance* to an agency which is setting it in motion. We should find, too, by experiment, that matter offers a similar resistance when its motion is being changed in any way, either in magnitude or in direction. This property of matter, which is much more than the mere inability to set itself in motion, is what Maxwell, Thomson, and Tait call inertia.

Now, we must distinguish very carefully between inertia itself, a property of matter, and the resistance which matter can exert in virtue of that property, somewhat as we must distinguish between a man's strength (that is, the property in virtue of which he can exert force) and the force which he may be actually exerting at any time.

Returning to experiment, let us attach to our fifty-pound weight a weak thread, capable of sustaining a few ounces. Pull gently and steadily in a horizontal direction upon this thread. A resistance is felt, to be sure; but the weight is moved perceptibly in the direction of the pull, and acquires, perhaps, a greater velocity than we succeeded in giving to it by a pull which broke the cord previously used.

This experiment proves that the resistance which a given body can, in virtue of its inertia, offer to an agency which is setting it in motion (and it would be the same for any change in its motion), is a variable quantity — let us leave the statement unfinished for a moment, while we look for the conditions and the law of this variation. When the stout cord was broken in pulling at the hanging weight, the latter acquired a small velocity, it is true; but it acquired that velocity in a very short time, a fraction of a second. When pulled by the thread, the weight acquired a somewhat greater velocity, it may be; but a much longer time was occupied in the change. The exact quantitative law, which can be determined by experiment with such apparatus as, for instance, Atwood's machine, is expressed by completing the interrupted statement in the following words: — being proportional to the rate at which the agency is changing the body's motion.

This definite law being recognized, there should be an end of the current vague attempts at explaining such phenomena as, for example, that of a half-open door pierced by a cannon-ball without being shut. Text-books too frequently say, in such a connection, that "masses of matter receive motion gradually and surrender it gradually," or that "it requires time to impart motion to a body as a whole," — statements from which the student is in danger of getting the idea, if indeed he gets any idea, that the *time* is required in order to draw things taut within the body, and get its particles to acting upon each other, somewhat as it takes time and a succession of jerks to take up the slack of a freight-train while it is being started.

Let us note again that the resistance which has just been considered is not the body's inertia, but is merely the manifestation of that property. But if the manifestations of inertia, in the case of a given body, are so variable, how can we speak of inertia as a measurable quantity, as Maxwell does in the quotation already made from him?

Suppose we take a certain body, and ascertain what force, reckoned in any units we please, is required to impart to this body a certain velocity in a certain time. Then we take a second body, and ascertain what force is required to give it the same velocity in the same time. The second force may be equal to, less than, or greater than, the first. If the forces are equal, we may say that the two bodies have equal inertias. If the second force is n times the first, we may say that the second body has n times as much inertia as the first. This is comparison of inertias. If we wish for what is called *measurement*, we have merely to select some body, and agree to call its inertia the unit inertia.

E. H. HALL.

LOCALIZATION IN THE BRAIN.

SINCE 1870, when Fritsch and Hitzig showed that the cortex of the brain was excitable, physiologists have been actively experimenting on it. Thus far, investigation has given rise to two theories regarding the function of this gray matter. One theory looks upon it as the seat of the higher intellectual activities: the other, considering it as a sort of mosaic composed of small areas, looks upon each area as possessing some definite function, either sensory or motor. Moreover, such is the nature of these areas, according to this theory of localization, that, if they be stimulated, perfectly definite movements or sensations are excited, while, if they be destroyed, the movements or sensations over which they preside are abolished.

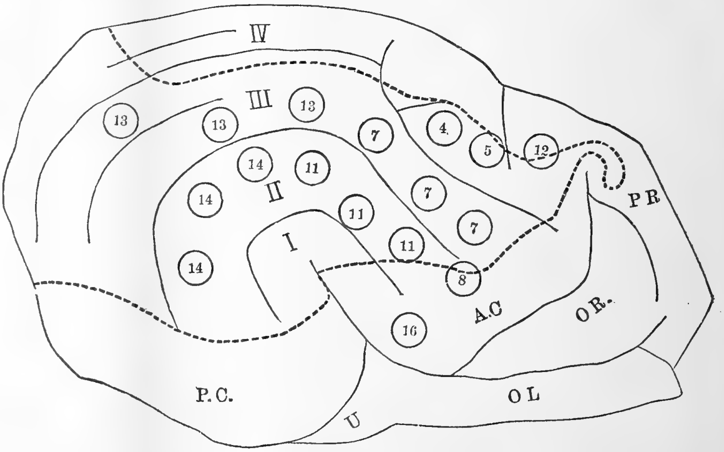
At the International medical congress held in London in the summer of 1881, these views were both ably represented; the former being supported by Professor Goltz of Strasburg, while Dr. Ferrier and Professor Yeo, both of London, represented the latter. Goltz had a dog, and Ferrier a monkey. The animals were exhibited before the physiological section of the congress, and each investigator stated his conclusions as based on the animals presented. Both animals were then killed, and their brains placed for examination in the hands of an eminent committee, consisting of Dr. Gowers, Dr. Klein, Prof. E. A. Schaefer, and Mr. J. N. Langley. The reports of this committee have recently been published in the *Journal of physiology* (vol. iv. Nos. 4 and 5); and, having now before us this complete description of the lesions, it is possible to estimate the value of the peculiarities exhibited by the animals while alive.

The dog presented by Goltz had been subjected, between November, 1880, and May, 1881, to five operations. By these a large portion of the cortex of both hemispheres had been washed away with a stream of water. Casually observed, this dog showed nothing abnormal in its bearing. It ran round the room, wagging its tail and sniffing about, as any dog is apt to do in a strange place. Its expression, however, was stupid, and its gait heavy; but it appeared to possess all its senses, and have control over all its muscles, — two points which are to be emphasized as of fundamental importance in the present discussion. This dog was, however, quite different in many ways from a normal dog. In travelling about, it avoided not only real objects obstructing its path, but those which were not real, — such, for instance, as a spot of sunlight on the floor, or a bit of white cloth spread flat.

Fear was apparently absent. The cracking of a whip and threatening gestures produced no effect; and, when an angry, spitting cat was held up to test the impression which it would make on this dog, it calmly began to lick the cat's face. It would eat dog's flesh, something which a normal dog is said not to do. When pent behind a low fence, it made no systematic effort to get out, although it apparently wanted to do so; the difficulty seeming to be that it did not know how.

Without further continuing the list of variations from the normal, it can be briefly said that this dog, though possessing his senses and not paralyzed, had yet lost something which goes to make up the difference between an intelligent and a stupid animal; or, to quote Goltz, there was a weakness of perception. The conclusions which Goltz drew from the actions of his dog are too obvious to need statement.

The monkey presented by Ferrier had been operated on seven months before. At that time what Ferrier calls the motor zone — a region about the fissure of Rolando — had been destroyed on the left side. This was done with a thermo-cautery. In the animal as exhibited, there was weakness in the right leg, and the position of the right arm was abnormal. No voluntary use of either of the limbs on that side had been noticed since the operation. Otherwise the



Right side of dog's brain, after Langley, slightly altered. I., first convolution; II., second convolution; III., third convolution; IV., fourth convolution; *A C*, anterior composite convolution; *P C*, posterior composite convolution; *O L*, olfactory lobe; *OR*, orbital lobe; *PR*, Prorean convolution; *U*, uncinate convolution. The circles numbered 4, 5, 7, 8, 11, 12, 13, 14, 16, represent areas localized by Ferrier on the brain of the dog, and have been taken from his fig 32, 'The functions of the brain,' p. 149. The broken line encloses the region which the lesion is known certainly to have covered, and within which all the gray matter of the cortex had been removed.

monkey was quite well. Dr. Ferrier briefly stated that he considered this paralysis as due to the destruction of the motor zone of the cortex, which presided over the muscles on the right side of the body, the destruction of which would, according to the theory of localization, produce this effect. It now remained for the post-mortem to show what were the lesions in both these cases.

Mr. Langley, to whom the right brain of the dog

was given, has made a very thorough report. Indeed, he reviewed the whole subject of the fissures and convolutions of the dog's brain before giving his observations in this particular case. His main conclusions are perhaps best indicated by a figure showing the extent of the lesion. This is traced on a schematic outline representation of the right hemisphere seen from the side.

In some places doubt as to the exact extent of the lesion rose from the obliteration of some of the fissures, and a possible dragging of the brain during cicatrization. The region enclosed within the dotted line in the accompanying figure leaves out all the doubtful points, and includes the part only which is certainly known to be covered by the lesion.

In order plainly to indicate the significance of this injury, some areas localized for the dog's brain by Ferrier have been inserted in the figure in positions which are approximately correct. The number of these areas involved, as can be seen at a glance, is very large.

The left brain of the dog was examined by Dr. Klein. Without going into the details of his report, it may be stated that the extent of the lesion was rather less than that on the right side. The destruction of the gray matter did not extend quite so far forwards, nor so far towards the base, but it was still extensive enough to include some two-thirds of the areas which were embraced by the lesion on the opposite side.

If, then, the theory of localization were correct, we should have expected to find this dog largely paralyzed on both sides of his body, and blind in both eyes. That this was not the case, the actions of the animal plainly showed. There was some degeneration found in the deeper parts of the brain, but it was apparently of little importance.

The brain of the monkey was examined by Professor Schaefer. The lesion was found quite strictly confined to the motor zone. It thus covered an oval region, occupying about the middle third of the brain, and bisected transversely by the fissure of Rolando, the ends of which extend beyond the oval on both sides. Beneath this, in the medullary centre, was a secondary lesion having about the same extent. The basal ganglia were not involved. But the very important fact was developed, that the pyramidal tract connected with the left side of the brain had undergone Wallerian degeneration through its whole extent, while there was also found an unexplained tract of degeneration in the left lateral column of the cervical cord. These deep lesions being discovered, it became at once impossible to decide whether the effects observed in the monkey were due to a removal of a certain portion of the cortex or not; so that it cannot be considered that in this case the monkey presented by Ferrier furnishes any evidence in favor of localization. From the dog, on the other hand, which was exhibited by Goltz, the conclusion is warranted, that large portions of the cortex can be removed without producing any of those effects which would be expected if the theory of localization were true; and at the same time there is some reason to believe that the removal of portions of the cortex diminishes general intelligence.

We have discussed but two experiments, and they in themselves are not sufficient ground for any generalization; yet the position in the scientific world, of all concerned, is such as to render these particular observations of more than usual importance in the history of this interesting question, and hence worth some passing attention.

Henry H. Donaldson.

THE WINTER OF 1879-80 IN EUROPE.

The meteorological conditions which characterized this phenomenally cold winter have been carefully studied by M. Teisserenc de Bort. There are but few as severe winters in a century, while the month of December was the coldest on record at Paris. This exceptional cold was due to, 1°, the position of the maximum pressure; 2°, the clearness of the sky; 3°, the presence of snow upon the ground; 4°, the calm which prevailed. These conditions were united for twenty-seven consecutive days. Proceeding from the characteristics of this particular season, the author discusses the subject of the persistence of areas of high and low pressure in certain localities, and the resulting weather phenomena. These 'centres of atmospheric action' destroy the parallelism of isobars and isotherms with the equator, and control the prevailing winds. Thus, an area of high pressure generally prevails in Siberia in winter, and a similar area at about 35° north latitude in the Atlantic, near Madeira. The displacement of these maxima produces modifications in the weather of the whole of Europe, causing these abnormal seasons. Three types of cold weather may be recognized: 1°, that characterized by the displacement of the Asiatic maximum towards Europe, in which the weather is dry and quite cold; 2°, that characterized by the removal of the Madeira maximum towards France and Europe, with low areas in Tobolsk and near the Azores, in which cold and calm weather prevail; 3°, that characterized by the displacement of the Madeira maximum northward, with relatively low pressures over central Europe and the Mediterranean, and giving rise to cold with dampness and snowfall.

Similarly, two types of mild weather may be noted: 1°, that characterized by low pressures in northern Europe, with the displacement of the Madeira high area towards Spain and the Mediterranean; 2°, that characterized by a general spreading of high pressure eastward to its maximum in Russia. These types are hardly distinct enough to be classed separately: both are accompanied by south-west or west winds, bringing warm and moist air from the ocean. While the fact of the controlling influence of barometric areas is fully recognized, it is not so easy to account for the displacements which are observed. The author supposes that these are due to changes in the thermic condition of different regions of the globe, but does not attempt to further investigate this subject. If it were possible to foretell the barometric conditions of

coming months, the problem of forecasting the character of a season would be capable of solution.

W. U.

OLIVINE ROCKS OF NORTH CAROLINA.

Much interest was attracted a number of years ago to the olivine rocks of North Carolina by the excellent paper of Dr. Genth, on 'Corundum and its alterations.' These rocks are also well known practically from their association with the mica and corundum mines of that state: hence any thing tending to elucidate the origin and history of these immense masses of olivine is of value. There has been recently published, in the Proceedings of the Boston society of natural history, a paper by Dr. Alexis A. Julien on these olivine rocks, which is of great value, even if some exceptions may be taken to his conclusions. The particular variety of olivine rock in North Carolina is designated as dunite; it having been named from Mount Dun in New Zealand, from which locality rock of this character was first described. In North Carolina the rock is found in oval or lenticular masses in a hornblendic gneiss; and a 'marked slaty lamination' is looked upon by Dr. Julien as stratification which dips at a steep angle. His reasons for regarding this banded structure as bedding-planes are, that, on microscopic study of thin slices, there is seen an alternation of coarser and finer irregular grains. Again: grains of chromic iron are found not only dispersed throughout the rock-mass, but also in thin bands alternating with the olivine bands. He found, however, a sharp break between the lamination of the olivine rock and the foliation of the hornblendic gneiss surrounding it. Again: when there has not been formed in the rock some material, of later date than the time the rock came into place, which serves as a cement to hold the olivine grains together, the rock is pulverulent and friable, like a loosely consolidated sand.

From the above, Dr. Julien draws the conclusion that this dunite is neither of chemical nor of eruptive origin, but rather an accumulation of *débris* from some older olivine rock of eruptive origin; that is, it is an olivine sandstone. The chief defect in Dr. Julien's reasoning is, that all the evidence which he gives in support of this view could exist equally well if the rock had some entirely different origin. In order to prove that any thing must have been formed in any particular way, we ought to seek for certain characters in it which could have been produced in that way alone.

Messrs. W. C. Kerr and C. D. Smith, who have spent much time in studying this olivine rock in the field, declare in favor of the eruptive origin of it; but they have published little or none of the evidence upon which their conclusion rests, and therefore one cannot judge as to its correctness. Every rock carries within itself, or in its relations to others, the story of its origin and subsequent history with more or less completeness. The correct reading of that story depends upon our skill and knowledge. If a rock is deposited in the hollows of another as a beach formation, it is easy to see that the effect it produces upon the boundary-rock is different from its action upon them as a lava-flow or an intrusive mass. So the last two cases present different relations, according to their origin, to the surrounding rocks. As a rule, it can hardly be considered safe to positively declare what the origin of an old crystalline rock is, until these relations have been carefully ascertained; and in this direction Dr. Julien's work is defective. The present writer's microscopic study of the North Carolina dunite showed him that the rock he was studying, even when destitute of some cementing-material, was not friable and pulverulent, while the sections to his mind presented characters belonging to eruptive rocks only. The olivine grains are separated by fine fissures, but every irregularity in the outline of one is matched by a corresponding irregularity in the adjacent bounding-grains. If these grains had been water or wind worn olivine sand, no such matching of the parts would have been possible. This any one can readily see for himself if he will examine any conglomerate, and observe the amount of interstitial material it takes to hold together and fit the pebbles to one another. Then let him remember that a sandstone is a conglomerate on a small scale, and, under the microscope, a conglomerate to the eye as much as the other is to the unaided vision. The olivine rock now under consideration has absolutely no interstitial spaces and no binding-material, but the grains are fissured and separated the same as the adjacent portions are separated in cracked and fissured glass. From this the conclusion naturally follows, that such structure indicates that these olivine grains were formed by the cracking of an olivine mass during the process of solidification, crystallization, and cooling; that is, from an eruptive mass.

Further, individuals of olivine are seen in polarized light to be made up of a number of distinct grains, as much separated by fissures from one another as the distinct individual grains are elsewhere in the section. This is a natural and common occurrence in an eruptive rock, but in a sedimentary one the parts ought to be scattered. Many of these individuals, too, are long, wedge-shaped masses with sharply pointed ends. If they had been water or wind worn grains they ought to have had these sharp edges worn, rounded, and broken. These long, lenticular, fissured individuals are also arranged at every angle to one another, when, if the rock were sedimentary, they ought to lie nearly parallel, and on their sides.

The alterations of the dunite described by Dr. Julien are important and interesting because they give rise to veins and other rocks. The corundum in these veins is looked upon as a secondary product, and not, as Dr. Genth held, the primary material from which many rocks originated. The change of the olivine rock to different rocks leads to the production of chalcedonic or cherty forms, hornblendic schists, talc schists, serpentine, etc. The change to serpentine comprises every variation, "from that in which the serpentine is diffused among the olivine

granules, merely as a minute fibrous network, or as films enveloping olivine cores, to that in which only minute particles of olivine survive as the nuclei of the granules, and to the final result of a true and complete serpentine."

Dr. Julien further claims, that the actinolites, amphibolites, hornblende schists, and many of the talc schists, steatites, and serpentines of the Appalachian belt, are the equivalents of the dunite of North Carolina.

The objections to some of Dr. Julien's views have not been offered from any spirit of criticism of his truly excellent paper, but for the purpose of causing a more thorough study of the field-relations of this rock, and a presentation of the evidence that study affords. If the evidence, then, sustains Dr. Julien's conclusions, his views will be accepted unhesitatingly. He has, indeed, given more evidence for his opinions than most writers on crystalline rocks are inclined to offer; for, as a rule, they appear to consider their mere dictum sufficient to prove the origin of any rock. It would seem that the time has come when statements regarding the origin of crystalline rocks cannot be accepted from *any* observer, unless these claims are accompanied by full and decisive proof of their correctness. To bring about this healthy state in the study of the North-American rocks, the present writer has labored for years, and will continue to labor.

M. E. Wadsworth.

ABOUT GREAT TELESCOPES.

Dr. Ralph Copeland of Dun Echt, near Aberdeen, when returning to Scotland by way of this country a few months since, made a tour of several North-American observatories; and in a late number of *Copernicus* he contributes a paper on the Dudley observatory at Albany, the Litchfield observatory of Hamilton college at Clinton, the Warner observatory at Rochester, the Toronto observatory (Canada), the McGill college observatory (Montreal), the Harvard college observatory (Cambridge), the Winchester observatory of Yale college (New Haven), the two observatories at Princeton, and the U. S. naval observatory (Washington). The noteworthy portions of the equipment of these establishments are briefly dealt with, and the work generally specified on which they are employed. Dr. Copeland, having enjoyed the good fortune of seeing through a number of the finest telescopes in all parts of the world, places on record, at the conclusion of the paper, his general impressions of the actual state of telescope-construction on both sides of the Atlantic.

First as regards their optical merits: it does not seem to him that any material difference as to the mere power of separating close double stars exists in the object-glasses made by the chief opticians in Europe and America. On a night of good definition, any of their telescopes may be trusted to divide a fairly equal pair of stars at a distance indicated by Dawes's table,[1] of which the following is a sufficient specimen: —

[1] Mem. roy. astr. soc., xxxv. 158.

Aperture in inches.	Least separable distance.
1.0	4.56″
2.0	2.28
3.0	1.52
4.0	1.14
6.0	0.76
8.0	0.57
10.0	0.46
12.0	0.380
15.0	0.304
20.0	0.228
25.0	0.182
26.0	0.175
27.0	0.169
30.0	0.152

We thus see that in this respect our telescopes are practically perfect, and also that the atmosphere on the very best nights is sufficiently steady to permit their full power to be used. If, however, we test them on double stars, of which the components differ very much in brilliancy, then it is by no means so easy to come to a certain conclusion. There is the secondary spectrum to contend with, respecting the character of which it may be said that a certain degree of personal taste or fashion exists. Some persons, notably opticians, seem to be little disturbed by a decidedly blue glare, while others prefer a wine-colored fringe. Perhaps, indeed probably, there is a physiological difference in the observers; for, if we suppose a person to be blind to the extreme blue and the violet rays only of the spectrum, to him an over-corrected object-glass would be perfect. With it he would be able to make out the closest companions of blue stars, or to see comparatively faint ones right up to the moon's bright limb. To such a person, however, an object-glass under-corrected to the same extent would appear to be a decidedly bad one. To Dr. Copeland, as well as to many of his colleagues, an average glass by Cooke or Grubb, and, to a less extent, by Clark, appears over-corrected; while one by Schröder, and some of the Munich glasses, appear under-corrected. But here an important practical difference enters into consideration, one which has been particularly experimented on by Mr. Russell of Sydney; viz., that the correction of an object-glass may be lessened by separating the lenses: so that an over-corrected object-glass may be adjusted to any desired extent, while one that is under-corrected can only be used in the state in which it left the maker's hands. As an example, it may be mentioned that the somewhat over-corrected object-glass of the 15-inch equatorial at Dun Echt has been materially improved by separating its lenses 0.2 of an inch, while a separation of 0.3 of an inch was found to throw out too much red about the primary image. This degree of improvement is best shown by the extremely linear character of the spectra of stars which it now gives. But in this connection it is only fair to mention, that, in making this object-glass, Mr. Grubb was limited to the relatively short ratio of 12 to 1 between the focal length and aperture. Opticians have not neglected to avail themselves of this property; and

accordingly we find three of the largest objectives in the world, — the 27-inch at Vienna, by Grubb; the 23-inch at Princeton, and the great Russian 30-inch, both by Alvan Clark & Sons, with their lenses separated by a considerable interval.

Assuming a large lens to be made of satisfactorily good disks, and having its curves and interval so adjusted as to give the best attainable results, there is another detail of construction which demands increased attention with every augmentation of size; i.e., the state of the surfaces of the lenses. Formerly it was too readily assumed, that, provided the curves were right, a few scratches more or less did not matter. There is a well-known story of an optician, who, on being blamed for turning out a badly scratched lens, replied that an object-glass was to be looked through, and not at. The optician was nevertheless in the wrong; for if delicate objects are under examination, no matter whether they are small companions of large stars, or minute satellites of bright planets, there can be no doubt that the finish of the objective plays a considerable part in their visibility. Nor is it merely necessary that the surfaces should be correctly formed and well polished: it is also requisite that they should be kept scrupulously clean, and, above all, free from grease, the slightest trace of which, when spread over a lens, must throw out irregular diffraction spectra, materially affecting the visibility of any small point of light in the neighborhood of a brilliant object. In this respect no practical astronomer should neglect to assure himself that an object-glass is really doing full justice to the maker.

Dr. Copeland's remarks on the mountings of large equatorials are especially pertinent. In America, he says, the mounting is just or barely sufficient to permit of a satisfactory use of the grand optical powers of their larger instruments; and no refined detail of auxiliary apparatus is attempted. On the continent we find the convenience of the astronomer studied in the most painstaking manner, and perhaps in no instruments in the world is this so carefully kept in view as in the finer German instruments. This is doubtless due in no small measure to the intimate relations which exist between the chief continental instrument-makers and practical astronomers; so that just that kind of apparatus is provided which experience has shown to be requisite. On the other hand, in the stability and rigidity of their mountings, the larger English and Irish instruments stand preeminent, while they year by year show a greater variety of really available subsidiary apparatus. Indeed, there can be little room for doubt that the elder Grubb, by his elegant arrangements for relieving the friction of both axes of the equatorial mounting, practically removed all limits to its size and strength; while in the little-known 25-inch refractor at Gateshead, by Cooke & Sons, we have a telescope which only requires to be efficiently used in a good atmosphere to show its great merits in all respects.

Finally, Dr. Copeland thinks, that whether we take large European or American instruments, the prospect is most encouraging, both to the astronomer and the instrument-maker. Nowhere can signs be detected that the utmost practical limit has been reached. A 27-inch glass can be managed with probably greater facility now than a 10-inch fifty years ago, and with something closely approaching to the full gain in power, due to increased size. The question of size now, as it did then, reduces itself to the production of suitable disks of glass and to cost. Here it is that silvered-glass reflectors offer facilities of which several distinguished investigators have not been slow to avail themselves.

ENTOMOGRAPHY OF HIRMONEURA.

DR. FRIEDRICH BRAUER has, during the past season, been able to add considerably to our knowledge of the life-history of the Hirmoneura obscura, and the results of his observations have been published (*Sitzungsb. akad. wiss. Wien*, p. 865). During the latter part of June he found within the nearly formed pupa of Rhizotrogus the second larval stage of the Hirmoneura, which resembles the first stage in the structure of the mouth-parts (see *Science*, No. 12), but lacks the pseudopods and ambulatorial filaments so characteristic of that stage. How and when the young Hirmoneura larva gets at the Rhizotrogus larva still remains unknown; but Brauer assumes (and I think he is quite safe in doing so) that it enters the larva (not the pupa) of the Rhizotrogus, and is a true parasite, and not merely a predaceous insect. Having entered the Rhizotrogus larva, it seems highly probable that the Hirmoneura larva has to undergo a kind of quiescent larval state of uncertain duration, but which suddenly changes to one of rapid development during the pupal state of the beetle, which lasts only from two to three weeks. Hirmoneura larvae in the second stage, of about eleven millimetres in length, were found in Rhizotrogus pupae; and ten days afterward the full-grown parasitic larva, twenty-two millimetres in length, was found. Brauer thinks it more than probable that the full-grown Hirmoneura larva, after emerging from the Rhizotrogus pupa, hibernates; the perfect fly appearing in July of the next year. This seems to me more doubtful. The Rhizotrogus larva is known to require two years for development. There are two alternatives for the Hirmoneura larva: either it is carried, by clinging to the beetle, into the ground, and remains quiescent, either attached to or near the Rhizotrogus larva, for nearly two years; or it is capable of independently discovering the Rhizotrogus larva when this last is in its second year's growth. The first seems to me the most probable, and would give two years for the development of the Hirmoneura, or even three if the full-grown larva hibernates. In either case, the young Hirmoneura larva is endowed with a sense which is truly marvellous, whether we choose to attribute to it consciousness of its acts, or ascribe them to 'blind instinct.'

Brauer raises a curious practical question, which would indicate that old pine fences or felled trees in a field may, in this particular case, serve to prevent the undue multiplication of the Rhizotrogus 'white grub.'

C. V. RILEY.

THE BONE-CAVES OF POLAND.

The bone-caves of Ojcow in Poland. By Prof. Dr. FERD. RÖMER. Translated by John Edward Lee, F.G.S., F.S.A. London, *Longmans*, 1884. 41 p., 14 pl. 4°.

OUR knowledge of primitive man in Europe, during the paleolithic age, is mainly confined to what has been learned in regard to the life and habits of the so-called 'cave-dwellers.' This has been principally obtained from the scientific exploration of numerous caverns, mostly situated in western Europe, in France, Belgium, and England; although inhabited caves are not wanting in other countries, especially in Germany, Spain, and Italy. The farthest point to the south to which they have been traced, is Sicily and the extreme south-eastern promontory of Italy; in central Europe they are quite rare; while the most easterly part in which any similar discovery has been made is Russian Poland. There, in the neighborhood of the village of Ojcow (pronounced Oïzoff), some fifteen miles or more north of Cracow, several caves have been discovered within the last ten years in the Jurassic limestone, which forms the sides of some of the beautiful valleys, in which there have been found human remains associated with the bones of animals, both those extinct and those still living. In the year 1874 Count Johann Zawisza of Warsaw began to publish in the scientific journals of that city, in Polish and French, the results of his careful explorations of many of them; and the *Matériaux* for that year contained a *résumé* of two of these papers. At the prehistoric congress held in Stockholm, also in 1874, Count Zawisza gave a brief account of his work in a paper entitled 'The age of polished stone in Poland.' He again called attention to his discoveries at the next congress at Buda-Pesth in 1876, mainly in the one called 'The cave of the mammoth;' about which he has since published more in the memoirs of the Anthropological society of Paris in 1878 and 1879.

In the *Matériaux* for January, 1882, M. G. Ossowski has given an account of the researches undertaken by him in 1879, on behalf of the Academy of sciences of Cracow, in several caverns situated in the eastern part of the *arrondissement* of Cracow, especially in the valley of Mnikow. About twenty of them yielded objects of human fabrication, all belonging to the neolithic period. Those fashioned out of bone were the most remarkable, and these are figured in two plates.

This comprises all that had been given to the world, so far as we are aware, in regard to the caves of Poland, prior to the appearance of the present work at Breslau in 1883. In it Professor Römer has given quite an elaborate report upon the explorations carried on by himself in 1878 and 1879, more especially in the cave of Jerzmanowice; together with an account of the results of Count Zawisza's explorations of 'The cave of the mammoth,' and some slight notice of what has been discovered by other persons in six different caverns. It is evidently intended to serve as a complete monograph upon the Ojcow caves; and from the fact that it has been deemed worthy of an English dress by the accomplished translator of Dr. Keller's 'Lake-dwellings,' and the handsome manner in which it is printed and illustrated, we hoped to find in it a fit companion to such classic works of prehistoric archeology as Lartet and Christy's 'Reliquiae Aquatanicae,' Dupont's 'L'homme pendant les ages de la pierre,' and Boyd Dawkins's 'Cave-hunting.' We regret to be obliged to state that our expectations have been disappointed, and that we have found the work quite unsatisfactory, at least upon the archeological side. In the paleontological department, there is evidence of knowledge and experience, leaving little to desire; but it is plain that neither the author nor the translator has any clear and adequate comprehension of the distinction between the paleolithic and the neolithic ages. We find the statement on p. 41, that "the remains of the ancient inhabitants consist of implements of hammered flint (paleolithic Tr.)," etc.; while on p. 7 it is said that in the cave of Jerzmanowice "no polished flint tools were found. The flint implements all belong to the older stone age." Evidently, 'implements of hammered flint' and 'polished flint tools' are intended to be contrasted; but, if we turn to the plates, we find that all the objects represented are either flakes, knives, or scrapers, and not a single true paleolithic implement is either delineated in them or described in the text. Very different is Count Zawisza's careful statement, that, "of the fourteen caverns I have excavated, one only had been inhabited by quaternary man; three belonged to the age of polished stone; two had served for a habitation of cave-bears; and in the others I found nothing" (*Cong. of Stockholm*, p. 260). Again: "The deeper we dug, the larger became the implements of the Moustier type, or of those of the quaternary gravels of Mesvin" (*Matériaux*, vol. ix. p. 90). So, too, Dr. Römer evidently is not aware that pottery was unknown in paleolithic times; for in his account of the cave of Jerzmanowice,

in which he declares that "the implements all belong to the older stone age," he states that "numerous pieces of burnt pottery gave further evidence of the existence of man in the cave."

In brief, we miss any indication of the employment of the strictly scientific methods of conducting explorations, according to which the exact depth and position in which each object was found are noted, whether it was covered by a floor of stalagmite or not, and what articles were found together; and we have instead only a jumble of miscellaneous remarks, however interesting in themselves. The plates are beautifully executed, and are valuable, especially those in which the animal remains are delineated; but the half-dozen devoted to archeology represent nothing absolutely novel, although several important specimens are figured. A number of human skulls and bones have been found in the different caves, which have been submitted to Professor Virchow's examination; and an elaborate account is given of his careful study of them. He reports that he finds nothing to indicate a high antiquity for them, and no material differences from the form of skull of the present inhabitants of the country: in short, there is nothing to prove that they are not the result of intrusive burials, and consequently not of the same age as the implements occurring with them.

Two interesting facts we find mentioned: one is the enormous amount of the remains of the cave-bear, discovered by Dr. Römer in the cavern explored by him, amounting to as many as one thousand individuals; the other is the proof obtained of the co-existence of man and the cave-bear from the finding of a vertebra of the bear, and an undoubted flint implement, embedded side by side in the same solid crystalline stalagmite. It is evident, from the general result of the explorations, that the caves were inhabited almost exclusively in neolithic times; although Professor Römer thinks that the occupation continued into 'the bronze age.' But the fibula figured by him in proof of this is plainly Roman; and in one cavern, even glass beads were found at a considerable depth in the deposit. Complete evidence of the very late occupation of one cavern, at least, is afforded by the discovery in it of a *denarius* of Antoninus Pius, of the year 140. But there is nothing remarkable in this, as Roman coins have frequently been found in the neighboring province of Silesia; and a hoard of early Greek coins was recently dug up near Bromberg, in Posen, on the lower Vistula. Their presence is to be traced with the greatest probability to the traffic in amber, which has existed from the remotest antiquity, and for which the trade route lay directly up the valley of the Vistula to Königsberg, in whose neighborhood similar finds have occurred.

The author states in his preface, that he had "the determination of undertaking a thorough investigation of these caves," but that he regrets, that, with respect to "the specimens found, it cannot always be positively stated from which bed in the caves they were taken; but the same is the case with most of the caves which have been excavated in Germany." We can but regard such a statement as this as disgraceful to German science, if true; and it certainly is not true of cave-explorations in other countries.

ILLINOIS COAL-PRODUCTION.

Statistics of coal-production in Illinois, 1883: A supplemental report of the State bureau of labor statistics. John S. Lord, secretary. Springfield, *Rokker pr.*, 1883. 144 p., 2 maps. 8°.

This report, published in advance of the regular biennial report of the bureau for 1884, makes quite a comprehensive showing in regard to the coal-production of the state, and demonstrates the increasing value of the industry. Since 1870 the output of coal in Illinois has increased from more than two and a half millions of tons to more than ten and a half.

In the introduction, Illinois is stated to have no equal, in the states west of Pennsylvania, in the extent of its coal-fields, the abundance and accessibility of its deposits, in its transportation facilities, or in its annual contribution to the fuel-supply of the country. As to the extent and accessibility of the coal-fields, and the facility of transportation, this statement is undoubtedly correct. Albert Williams, jun., in the 'Mineral resources of the United States,' estimates that the state contains a total of 28,845,000,000 tons of coal. The numerous railroads with good grades furnish cheap transportation, and in Chicago and St. Louis the requisites of two great central markets are found. As far as the production is concerned, Illinois is perhaps equalled by Ohio. The statistics of the latter for 1883 are not at hand, but the rate of increase is probably about the same in the two states. Mr. Joseph Nimmo, in the abstract of statistics for 1883 (published by the U. S. treasury department), gives the production of coal in Ohio for 1882

as 9,450,000 tons; while Mr. Lord, for the same year in Illinois, gives 9,115,653 tons. Coal is mined in forty-nine counties in Illinois; and the number of mines is 639, employing nearly 24,000 men and a capital of $10,396,540. The production was 10,508,791 tons for 1883, valued at $15,310,521. This was an increase of 1,393,414 tons over the output of 1882. The average value per ton of the coal at the mines has been $1.46 for the past three years. There has been a marked decline since 1870, when it was $2.32.

The report gives a statistical summary for the state; the complete statistics of each county arranged in alphabetical order; and a comparative table for 1882 and 1883, showing the number of men employed, the product in tons, and the average and aggregate values.

There are also papers on 'Miners' wages,' and 'Casualties in mines;' and a detailed description of 'the Diamond-mine disaster at Braidwood,' with a diagram of the mine, is given. The subject of state legislation in the interest of the miners is considered, and statistical tables of the various inspection districts are presented, illustrated by a map showing their boundaries. These are followed by a list of the railroads in the state on the lines of which coal is found, with the names of the towns and stations on each where it is mined and shipped.

The average wages received by the miners is stated to be ninety cents per ton. During the year, 365 casualties occurred, involving the loss of 134 lives. This was at the rate of one for every 78,424 tons of coal, or one man in every 146 employed under ground. The catastrophes at Braidwood and Coultersville, in which 79 lives were lost, of course swells the list, and makes it exceptional; but, leaving them out, one life was lost for every 192,887 tons of coal taken out, which is an excessive death-rate for mines as free from explosive gases as the mines of Illinois are. In the bituminous mining-region of Pennsylvania the average for 1882 was one death to every 277,124 tons of coal mined; and in Great Britain the statistics for eight years, ending with 1880, show that for every 143,667 tons of coal taken out there was an average of one death.

In the Illinois mines the larger number of the miscellaneous accidents are caused by the falling of the roof, against which, as the report says, the miners are usually able to protect themselves. Familiarity with the danger, however, leads them in many cases to neglect the setting of props. Twelve of the 365 accidents were due to gases.

The report concludes with an enumeration of the state mining-laws.

Although residents of Illinois will be especially interested in this report, there is a great deal of material in it that is of general interest and practical value.

CARPENTER'S ENERGY IN NATURE.

Energy in nature: six lectures upon the forces of nature and their mutual relations. By W. L. Carpenter. London, *Cassell*, 1883. 15+212 p., illustr. 12°.

When a man has been driving a butcher-wagon, or throwing trunks, or wading about in the cold and wet all day, and has no attractive fireside to retreat to in the evening, it must be comforting to find a well-warmed and brightly lighted hall standing open, with a platform at one end loaded with bright apparatus, and curiously colored diagrams on the walls.

The weary man walks in and takes his seat among a crowd of equally curious men, or only equally weary if *habitués*, and after rubbing his hands, and smoothing his hat across his knees, gives a few furtive glances at the lecture-table, and awaits events.

Over the uppermost diagram there is posted in the boldest letters, 'Energy in nature.' Our tired friend has a flickering thought that it might be well if there were no energy in nature. With Nature he was acquainted when a boy, possibly, and has a certain system of philosophy in regard to her workings. He once saw a man who could discover springs of good water by means of an apple-twig. He has leaned his head against telegraph-poles to hear the despatches, or has watched for them as they passed on the wire. He has always been taught that each 'new moon' is a new moon, and, to the best of man's knowledge, made of some common substance necessarily. He is not aware that any of these cherished notions are to be jarred this evening; and, thanks to soothing sleep, they may not be.

The lecturer appears, — a man well acquainted with the mechanical theory of heat, the kinetic theory of gases, the peculiarities of a magnetic field, and the working of an induction-balance, brilliant results of the labor of man, — and has come this evening to flash these jewels before the eyes of his motley audience.

The lecturer begins; and the listeners catch 'electricity,' 'heat,' 'sand,' 'wood.' Two close their eyes and nod (the 'regulars' have already closed their eyes and nodded). 'Energy is the power of doing work,' the lecturer

says: the sleeper opens an eye. 'Force is simply the expression of the rate or speed at which any change takes place in matter:' the eye closes.

The lecturer, building his hopes on the staring eyes of a young man in the front row and the rapidly running pencil of the young woman in the second, dilates upon the first two laws of motion, and approaches the third. He notices a frightened look in the young man's face, and that the pencil has stopped, and says, "Action and reaction are equal, but for present purposes it need not be here discussed."

It may be said that the book-binder's apprentice over the clock has been omitted from this account of the audience. That is very true; but it must be understood, when a popular lecture is given, that it passes right over the heads or through the heads of nearly all who are there; that the results are only to be found in the minds of a stray few. With this granted, one may acknowledge that the blue lights and red lights of the experiments may draw applause, but that the main result of the evening will be a restless sleep for the majority, and a pleasant pastime for a few.

With the fire of the experiments buried in the black and white of woodcuts, and the awakening influence of the speaker's voice gone, the same half-told facts appear weak when read from the pages of a book.

Mr. Carpenter states in his preface, that kind friends advised the publication of his lectures; but the lectures being of the class which hint at rather than discuss the problems of physics, and intended to lead the listener to think he is learning when he is only listening to pleasant chat, it would seem that this advice must have been of the kind which is not meant to be followed.

SOME STATE AGRICULTURAL EXPERIMENT-STATIONS.

Annual report of the Connecticut agricultural experiment-station for 1883. Printed by order of the legislature. New Haven, *Tuttle, Morehouse, & Taylor, pr.*, 1884. 120 p. 8°.

Fourth annual report of the New Jersey state agricultural experiment-station for the year 1883. Vineland, *Wilbur pr.*, 1883. 112 p. 8°.

THE report of the Connecticut station for 1883 presents a good illustration, both of the value of experiment-stations and of the rather narrow limits within which their activity has been in most cases thus far confined. This oldest of the American stations owed its origin to the demand for an efficient control of the quality of commercial fertilizers. It was in its inception, and has remained to a large extent, a fertilizer-control station; and this, not from any lack of interest in the problems of agricultural science, nor from any incompetence on the part of its officers to solve them, but simply from force of circumstances.

During the winter of 1882–83 the station was without laboratory facilities, and the present report covers about nine months of work. Of its hundred and twenty pages, about seventy are devoted to fertilizers, two hundred and nineteen analyses of which are reported. "Nearly one-half of them are samples of complex composition, each one requiring six determinations in duplicate." The amount of work which this involves can be fully appreciated only by a chemist, but its effect in limiting the amount of other work done is obvious.

Aside from fertilizer analyses, we find in this report numerous tests of the vitality of seeds, together with a description of a new and convenient form of apparatus for the same; analyses of feeding-stuffs, and a table of the composition of American feeding-stuffs compiled exclusively from American analyses by Dr. E. H. Jenkins; analyses of the milk of Ayrshire cows, and of market milk; analyses of oak and chesnut leaves at different periods of growth; and divers minor matters, including notes on some analytical processes.

It will be seen, that, while considerable work other than fertilizer analysis has been done, it is all, so far as reported, laboratory work. Of experiments with living plants or animals, or even with the soil from which they draw their sustenance, we find no mention. As we have already said, this fact is largely, if not entirely, the result of unavoidable circumstances. We mention it here, not to find fault, but to express the hope, that, with its new equipment and increased income, the Connecticut station will find means and opportunity to enlarge the scope of its work, and attack some of the numerous problems in what we might call applied biology, which are waiting solution.

The report of the New Jersey station shows points of resemblance to, and of difference from, that of the Connecticut station. As in the former case, the largest draught upon the resources of the station has been for the analysis of fertilizers, a hundred and ninety-four of which have been examined. Unlike the Connecticut station, the New Jersey station had ready to its hand tolerably good facilities for conducting field and feeding experiments;

and to these, and the auxiliary chemical work which they involve, the residue of its energies has been directed. These experiments include comparisons of green rye with rye ensilage, and of dried fodder-corn with corn ensilage, as food for milch-cows; field trials with fertilizers on various crops and on various typical soils in the state; experiments upon sorghum as a sugar-producing plant, and preliminary work on sweet-potato disease.

Not all of these experiments are of the highest order; but they are accurate and painstaking, and they touch the actual interests of the farm more closely than any mere laboratory work, however excellent, can do. The experiments on sorghum were mainly upon the effect of fertilizers upon the yield of sugar, and gave the interesting result that the yield of sugar was more favorably affected by potash than by any other single substance, and that, with the addition of nitrogen to the potash, the largest yield of sugar per acre was obtained. Sulphate of potash surpassed the 'muriate' in every case. Both sorghum bagasse and seed (the whole plant cut for fodder) and sorghum ensilage proved very satisfactory fodders for cows and pigs.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Mineral springs in eastern Tennessee. — Mr. F. M. Pearson, who carried on topographic work for the survey last summer in eastern Tennessee, reports that the section of the state upon the map of which he is now engaged is full of mineral springs belonging to the classes of sulphur and chalybeate springs. He mentions particularly Bean's Station Valley, in Grainger and Hawkins counties, as being the locality of some twenty springs, a number of which have been improved, and are places of resort. On the north-western side of the valley lies the 'Poor Valley Ridge,' which extends for a distance of some thirty miles from the north-east to the south-west. This ridge is separated from the Clinch Mountain, which is on the north-west and parallel with it, by a depression or hollow known as 'Poor Valley.' In the latter, numerous small streams rise, separated by low divides, which, after flowing in the valley for short distances either south-west or north-east, turn and reach Bean's Station Valley through gaps in the Poor Valley Ridge. At every one of these gaps on the south-east side of the ridge, sulphur springs are found. Most of these springs are unimproved, as far as conveniences for using the waters are concerned; but those at which hotels have been built are among the most popular places of resort in the state. Beginning at the south-west, where the ridge abuts against the Clinch Mountain, the first springs of importance are 'Lee's Springs,' which are situated at the extremity of the Poor Valley Ridge, or rather partly between it and the Clinch Mountain. Powder Spring (named from the odor of the sulphuretted-hydrogen gas), at Powder Spring Gap, five miles farther to the north-east, is the next important locality. Following the ridge fifteen miles from this point, toward the north-east, brings one to 'Tates Springs,' one of the most noted localities in Tennessee. There are good accommodations here; and stages connect with the Eastern Tennessee, Virginia, and Georgia railroad at Morristown. Stages connect 'Lee's Springs' with Strawberry Plains, a station on the same railroad.

Hale's red and white sulphur springs, in Hawkins county, five miles north of Rogersville, are also resorted to, and are on the same line as the other springs enumerated. There are also several chalybeate springs on or near the same line, in Hawkins and Grainger counties. Other well-known watering-places, determined by the presence of mineral springs, in the region surveyed by Mr. Pearson, are 'Montvale Springs' in Blount county, 'Oliver Springs' in Anderson county, 'Austin Springs' in Washington county, and 'Galbraith's Springs' in Hawkins county.

Burk's Garden, in Virginia. — The peculiar topographical system of long narrow valleys, with streams flowing from their opposite ends to the middle, and thence at right angles across or through one of its boundary ridges, which is one of the striking features of the physical geography of the country surveyed by Mr. Morris Bien in the southern Appalachians (described in *Science*, No. 56), gradually changes, as it is traced north-eastward from the valley of east Tennessee, until in Tazewell county, the northern county of south-western Virginia, is found the most southerly instance of a topographical feature common in Pennsylvania. This is Burk's Garden, a beautiful oval valley, eight miles long by four and a half miles wide. It is surrounded by a ridge averaging more than twelve hundred feet in height. The valley contains some of the richest blue-grass land in the state. Its drainage forms one of the heads of Wolf Creek, which affords numerous examples of sink-hole drainage, so common in the area surveyed by Mr. Bien. This stream leaves the valley by flowing through the western side of the oval range in a deep and rugged gap, or cañon as it would be called in the west. This valley well deserves the name of 'garden,' for it is one of the most beautiful spots in Virginia. The first glance recalls Johnson's description of 'Happy Valley' in Rasselais, and it is without doubt destined to become a popular mountain resort.

It is located in the southern part of Tazewell county. South-east of it is the valley of Holston River, in which there are large gypsum deposits. The fertility of Burk's Garden may perhaps be due to the presence of gypsum. Elk Garden, in Russell county, south-west of Tazewell, is somewhat like Burk's Garden, but not so well defined, although it may have been so in the past.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Trenton natural history society.

April 8. — Mr. F. A. Lucas arraigned the English sparrow, Passer domesticus, as a nuisance; stating, that, after several seasons of careful scrutiny, he had never seen the bird capture or destroy a single larva. It will chase butterflies, fight with our native birds, and drive them away; it will devour the grain of the farmer, and the seeds cultivated for commercial purposes; but to do any thing useful is against its principles. It is stated by J. H. Gregory, a veteran seed-grower, to be one of his greatest enemies. Mr. Lucas referred to contests which he had witnessed between Passer domesticus and Picus pubescens, the hard-working Certhia familiaris, Troglodytes aedon, and Regulus satrapa; in some instances several sparrows uniting in the attack. He had also seen the bird perched on a tree whose branches were loaded with webs of certain caterpillars, without even noticing them, but waiting for the crumbs from the breakfast-table. The pestiferous foreigner is, in this state, protected by law, a penalty of five dollars being imposed for the killing of one. —— Dr. A. C. Stokes communicated a paper on Cynips quercus-cornigera of Osten-Sacken, exhibiting the spinous galls and several microscopic dissections of the fly, especially of the ovarian tubules, to show the arrangement of the pedunculated eggs. The numerous tubules are in two clusters, radiating from common centres. The peduncle of each egg is twisted about the egg next to the rear; so that, when deposited on the twig, the stem is directed upward, and develops into the hollow, thorn-like body projecting from the gall. The fly escapes by gnawing a small hole in one side of this body, above the surface of the excrescence. Several mature flies were removed from these woody capsules in December; and from the same gall, at the same time, were taken larvae and pupae. —— At a previous meeting, Prof. Austin C. Apgar referred to the spawning of Fulgur caniliculata, stating that the eggs were deposited every month, except, perhaps, in the winter. A recent experience on the New-Jersey coast has led to the belief that spawning may take place at any season. In the region about Cape May these long clusters of egg-cases are popularly supposed to be the skeletons of defunct snakes.

Engineers' club, Philadelphia.

April 5. — Mr. Henry G. Morris gave a brief description of an atmospheric elevator, consisting of a closed cage or car working in an air-tight well; the air-pressure, supplied by a 'Root' or other pressure blower, being admitted to the top or bottom of the cage in descending or ascending. The doors at the different stories opening inwards, the pressure of air keeps them closed until the interior of the car is brought opposite, when, the pressure being relieved, the door can be opened into the car. The car being counterbalanced, only a comparatively slight pressure of air, equal to a water-column of from six to eight inches only, is required to move an average load on a car six feet square. The escape of air beneath the car being at all times readily controlled by the attendant, it is impossible for the car to descend at a dangerous speed; and other obvious features render this form of elevator comparatively safe. —— Mr. Henry G. Morris also exhibited a sample of seamless copper tube which had been compressed endwise under a steam-hammer, and showed peculiar foldings of the metal into overlapping equilateral triangles forming an interior hexagonal section. —— Mr. John T. Boyd described a new design for parlor-cars for the Pennsylvania railroad. —— The secretary presented for Mr. Edward Parrish an illustrated description of Powers's disinfecting-tank and automatic siphon. —— Mr. William L. Simpson exhibited a remarkably perfect casting of a toad, the pattern used being the toad himself.

Minnesota academy of natural sciences, Minneapolis.

March 4. — Mr. C. L. Herrick mentioned the recognition of a genus of lynceid crustaceans, Monospilus, new to America. M. dispar is peculiar among Cladocera, in that, living in the filth at the bottom of pools, it not only fails to completely moult its periodically produced coverings, but fails to develop the compound or imago eye, while the macula nigra persists through life as the functional visual organ. This most interesting form has outward resemblances to Iliocryptus, while its real affinities seem to be with the higher lynceids from which its habits have degraded it. Mr. Herrick regards the Minnesota form as identical with that of Europe. He also presented a tabular statement of the distribution of the fresh-water crustacea of the orders Cladocera and Copepoda; showing a remarkable conformity between the faunas of Minnesota and Scandinavia, and a very large percentage of identical species. Southward, toward the Gulf of Mexico, the number of species becomes less, while the percentage of new species increases. Several species rarely found in Minnesota become common southward, and these are always species differing from those of Europe. Such species, however, represent usually intermediate species between extremes found associated at the north, or links between genera. Such species are Simocephalus daphnoideus Herr., which is a link between Simocephalus and Daphnia and Scapholeberis angulata Herr., which stands related to

Simocephalus. Pseudo-sida bidentata Herr. unites Sida and Daphnella. Mr. Herrick inclines to the opinion that the fauna of the states south of the Ohio River is a remnant of a pre-glacial one; while in the drift-covered areas a new circumpolar fauna has arisen, measurably independent of the previous one, though, of course, derived from it. The paper led to some discussion of geological evidence of the origin and persistence of types of fresh-water animals, and a comparison of the specialized phyllopod fauna of America with the cosmopolitan character of other fresh-water groups. —— Mr. Warren Upham spoke of the progress made in cataloguing the plants of Minnesota, a work on which he is engaged. Much interest is shown by the botanists in all parts of the state in contributing material and notes. The total number of species of flowering plants and ferns now known to occur in Minnesota, growing without cultivation, is 1,527, belonging to 546 genera, which represent 115 families or orders. Of these, 125 species are introduced, being foreign plants that have become established or naturalized, leaving 1,402 that are aborigines. Up to the present time, only about half as many introduced weeds are known in Minnesota as in New England; the difference being due to the later settlement of the former section. —— Mr. John B. Leiberg contributed a paper on plant-life in Montana and Dakota. It was stated that many species found were met with in the south-west only at high elevations. Their growth was of a luxuriance not seen in Minnesota. Only one kind of cherry was found west of the Missouri River along the line of the Northern Pacific, this being the little sandy cherry. Golden-rod was abundant. But one kind of pennyroyal was met. Fully one-half the grass found west of the Missouri was of one kind. Only two species of ferns, and but few mosses, were seen. The great number of fossil trees between Bismarck and Llendive was a fact of particular interest. From the stumps, some of them ten feet in diameter, the trees originally must have been of immense size.

NOTES AND NEWS.

In addition to the signal-service note mentioned in our editorial columns, there is another, no. vi., by the same author, on wind-velocities as determined during the summer of 1882, by hourly records of automatic anemometers at Chicago, and on the lake crib, three miles out on Lake Michigan, whence the city's water-supply is taken to the shore by a tunnel. The discussion shows the local peculiarities of the wind with much distinctness. The general ratio of velocity in Chicago to that at the crib is about 1 : 2, even though the anemometer in the city is a hundred and three feet above the ground, while that on the lake is only fifty-seven feet above the water; proving a marked control exercised by even so smooth a land-surface as that about Chicago in retarding the winds, — a control probably much strengthened by the buildings in the city. The diurnal variation of velocity is shown clearly at both stations: the maximum occurring about three or four in the afternoon, on land, and about four or five over the water; the minimum being rather uniformly maintained from ten in the evening, on through the night. The ratio of increase is much greater at the former (5.6 : 9.6) than at the latter station (11.5 : 13.5), as might be expected, both from the greater diurnal changes of temperature on land, and from the fact that at the time of maximum velocity on land the lake-breeze prevails. Directions are given only for the city station: they exhibit the phenomena of land and sea breezes in good form. The average of four months, here copied in fig. 1 with slight change, shows the south-west land-breeze from four in the morning till eleven; then there is an abrupt reversal to the north-east lake-breeze, which persists from noon till ten at night, followed by a gradual right-handed veering as the land-breeze is established again. The veering is found with greatest regularity in the July averages. Fig. 2 illustrates the immediate reversal from west-north-west to east-south-east at noon, followed by the

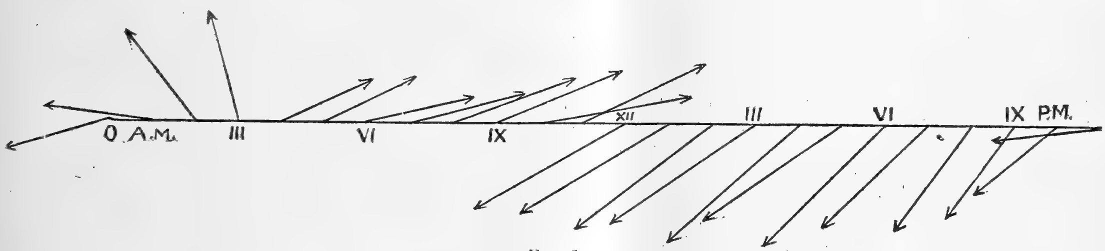


Fig. 1.

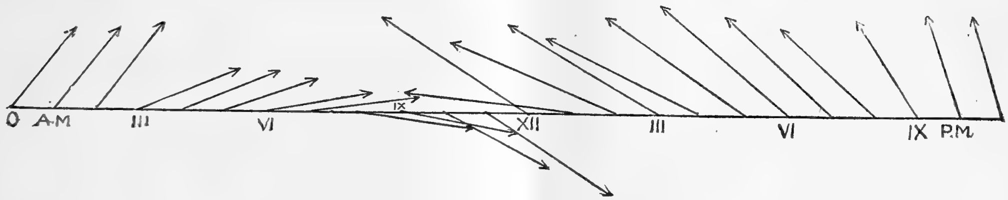


Fig. 2.

gradual hauling-around to west-north-west again in the succeeding twenty-four hours. The arrows are here drawn proportional to the velocities (maximum, 9.9 miles an hour; minimum, 5.6), as they should better have been in the original. The veering in the other months is much less regular. The little pamphlet affords excellent material for use in teaching, as well as for use in improving weather-predictions.

No. xi., by Lieut. F. K. Ward, of the same series of notes, treats of the elements of the heliograph, for use in military signalling, with the advantage of silently calling the attention of those to whom the signals are addressed without being visible to the enemy. No. xii., the latest of the series, by Sergeant J. K. Finley, is on the special characteristics of tornadoes, giving a concise description of their peculiarities. We should have been glad to see in it a statement of what the signal-service is attempting, in the way of tornado studies, by means of its special reporters.

—R. Baron, writing to *Nature* from Antananarivo, Madagascar, of a curious habit of insects, says, "One morning, while sitting by the side of one of these streams, I noticed a papilio, which is an insect measuring about four inches from tip to tip of its wings, resting on a wet bank; and, wishing to procure it as a specimen, I approached it as gently as possible, the creature being apparently so absorbed in what it was about as to be totally unconscious of my proximity to it. Noticing strange and unaccountable movements, —sundry jerks and probings with its proboscis, —I quietly sat down near it to watch it more closely. I observed that every second or two a drop of pure liquid was squirted (not exuded merely) from the tip of its abdomen. I picked up a leaf that was lying near, and inserted the edge of it between the insect's body and the ground, so as to catch the liquid. Unfortunately, I had no watch with me at the time, nor means of measuring liquids; but I reckoned that about thirty drops were emitted per minute. I held the leaf for about five minutes, — as nearly so as I could reckon, —and at the end of that time there was caught in it about a saltspoonful of what seemed to be pure water, without either taste or color. After watching the butterfly for a time, I seized it by the wings between my thumb and fingers with the greatest ease, so utterly lost did it appear to be to what was going on near it. In another spot I saw as many as sixteen of these large butterflies within the space of a square foot, all engaged in the same strange action."

—According to the London *Academy*, an ancient human skull has been found at Podhaba, near Prague. It was unearthed in a bed of chalk where the tusk of a mammoth had been dug out a few days previously, which gives an indication of its age. The characteristics of this skull are the extremely low forehead and the excessive development of the ridges, in both of which points it resembles the famous Neanderthal skull, though its facial angle is yet lower.

—The Entomological society of Washington has organized with the following officers: president, Dr. C. V. Riley; first vice-president, Dr. J. G. Morris; second vice-president, George Marx; recording secretary, E. A. Schwarz; corresponding secretary, L. O. Howard; treasurer, Benjamin P. Mann; executive committee, the officers and Dr. W. S. Barnard, P. R. Uhler, and Dr. A. J. Shafhirt. The first regular monthly meeting of the society was held April 3, in the council-chamber of the U. S. national museum.

The active membership list of the society numbers over twenty names. Regular meetings are held on the first Thursday evening of each month.

—The pilot chart of the hydrographic office for April embodies several neat improvements on the preceding numbers. The printed supplement is replaced by a greater detail of conventional figures, with dates, printed in red on the chart; so that there is no longer necessity of looking elsewhere for needed information. The rig and attitude of wrecks are graphically represented, the name and date of observation being placed beside them. Wrecks observed more than once are plotted in all their positions with dates, and connected by a dotted line. Thus, from Jan. 7 to March 12, the schooner Maggie M. Rivers had drifted from off Cape Hatteras about five hundred miles east-south-east, obliquely *across* the ordinary course of the Gulf Stream. An intermediate position was noted on Feb. 6. One water-spout is recorded for March 3, two hundred miles east of Norfolk. It would be worth while to give the hour of such transient phenomena. Bergs and field-ice were very plentiful south-east of Newfoundland. Hereafter the charts will be sent to press the first of every month. The news of the previous month will be given as far as received, and any thing coming in later will appear on the next issue.

—It is rather late, but perhaps not quite too late, to call attention to the exceedingly important article by S. P. Langley, on the determination of wave-lengths in the invisible prismatic spectrum, in the March number of the *American journal of science*, simultaneously published, also, in the *Philosophical magazine* and some of the continental journals.

It gives the first, and so far the only, reasonably accurate wave-length determinations in the lower invisible portion of the spectrum. The results were obtained by a very ingenious and unexceptionable combination of grating and prism, and their correctness is beyond dispute within the limits of accuracy assigned. They show conclusively that the corresponding wave-lengths published by previous (and some contemporaneous) investigators are, at best, only roughly approximate, because founded on extrapolation from formulae which break down in the region of longer wave-lengths. The formulae of Redtenbacher, Cauchy, and Briot, were all investigated, and all fail; Briot's turning out the least inaccurate. Professor Langley's work makes it evident that the theory of dispersion needs revision and perhaps reconstruction.

Some of the results given in this article have been published before, within a year or two, in a fragmentary way, in the *Comptes rendus*, and in papers read before the National academy and elsewhere; but we

have now, for the first time, a connected statement of the whole investigation, which lays a foundation for future extended work in the same direction.

A casual reader would hardly be likely to appreciate the immense amount of labor involved in the research, both in observation and computation: but all acquainted with this sort of work will know that it must have been exceedingly laborious, tedious, and delicate; and specialists will await with great interest the publication of the unabridged memoir, in the Transactions of the National academy of sciences, with all the original records and details of the observations.

— In a paper published in *Van Nostrand's magazine*, Professor Thurston introduces a report, by Messrs. Brooks and Steward, on tests of an Otto gas-engine made at the Stevens institute of technology in the spring of 1883. The machine was furnished by the builders, and was subjected to a careful test, determining the method of distribution of heat, in useful effect and in wastes. Earlier determinations, under the direction of Professor Thurston, had been made, with results, in one case, given in illustration, as follows: —

Useful (dynamometric) work	14.27
Work of pump	0.42
Friction of engine	4.10
Heat 'exhausted' from engine	23.55
Heat wasted by water-jacket	46.90
Loss by radiation, etc.	10.76
Total heat supplied	100.00

The consumption of fuel varied from twenty-one to twenty-four and a half cubic feet per horse-power and per hour. The friction of mechanism was four or five per cent of the total energy of the fuel, or about thirty per cent of the useful power. The water-jacket carried off from forty-five to fifty-five per cent of the heat of combustion. The engine delivered seven to nine horse-power.

The trials of 1883, at the Stevens institute of technology, were made with an engine rated at ten-horse power. The air and gas were *both* measured by meter, — probably the first time that this had been attempted. It was found that the real proportions of air and gas were not determinable, except by metering both, as here done. The fact was proven that combustion continues, even after expansion has progressed to a very considerable extent, — a fact that had been before suspected, but probably never before proven. The distribution of heat was as follows: —

'Indicated' work	17.00
In exhaust	15.50
In water-jacket	52.00
Lost by radiation, etc.	15.50
Total heat	100.00

In the 'indicated' work are included useful work, and friction of engine, the latter amounting to about 0.20 of the former.

The cost of operation of the gas-engine is given at 8.75 cents per horse-power and per hour, — considerably more than the steam or the hot-air engine, when working continuously; but the comparison is more favorable to the gas-engine for discontinuous work. The expense of the gas-engine will also be greatly reduced by the introduction of special 'heating-gas,' which can be supplied at one-half the cost of illuminating-gas.

The report affords an unusually full collection of valuable data for use in the construction of the theory of the gas-engine. It is remarkably well worked up, giving the equations of the expansion-lines; composition and specific heats of the gases; pressures, volumes, and temperatures at the various portions of the cycle; and all items of cost.

— At the meeting of the Linnaean society of London, on March 6, Professor Cobbold gave a verbal account of a communication from Dr. P. Manson of Hong Kong, in which the author furnishes fresh evidence as to the *rôle* of the mosquito considered as the intermediary host of Filaria sanguinis-hominis. Dr. Manson has verified his previous observations in the most complete manner, and he now recognizes and describes six well-marked stages of the Filariae whilst they are dwelling within the body of the insect. In the discussion following, Dr. T. R. Lewis confirmed Manson's statements in many particulars.

— M. Tisserand, assisted by MM. Bijourdan, Callandreau, and Radau, issued on Feb. 15 the first number of a new astronomical monthly, entitled 'Bulletin astronomique,' to be published under the auspices of the Paris observatory.

— *Nature* announces that at the final meeting, March 21, of the general committee of the International fisheries exhibition, the balance of the funds was disposed of. The surplus amounts to over £15,000; and of this, £10,000 were allotted to alleviate the distress of widows and orphans of sea-fishermen, while £3,000 were voted as an endowment to a society which is to be called 'The royal fisheries society,' whose functions will be somewhat similar to those of the Royal agricultural society. The remaining £2,000 are kept in reserve.

— For the purpose of a scientific inquiry into the amount and fluctuation of the rainfall in different parts of the world, A. R. Binnie, Town Hall, Bradford, Yorkshire, Eng., wishes to collect long and continuous records of rainfall extending from as early a date as possible. 1°. The records should state the annual falls only, as taken year by year without a break, for periods of at least fifteen years; but the longest possible period is most desired. 2°. The name of the place of observation, with, if possible, the latitude and longitude, and its elevation above the sea-level, should be given. 3°. The total annual fall should be expressed in millimetres, English inches, or local or obsolete measures; but if in either of the latter, their equivalent in millimetres or English inches should be given. 4°. The name of the observer, or authority, or publication from which the record is obtained, should be given. 5°. The records should be from observations made at a single station, and should not be compiled from the records of two stations; but the greatest number of different records taken at different stations is desirable, to avoid local errors or peculiarities.

— The gunpowder-mills owned by Messrs. W. H. Wakefield & Co., near Kendal, Eng., are now lighted by the electric light; they being the first works of the kind where this mode of illumination has been adopted. The works are very extensive, at least two miles in length. The dynamo is placed about the centre of the works. Very long mains were necessary, as each dangerous building is about two hundred yards from its neighbor. Over head, bare wires were found to be the best for conveying the current. These were carried on insulators on posts and trees along the route, four to eight lamps being necessary to each. The lamps used are the new pattern, twelve-candle power Swan lamps. The dynamo runs almost continuously day and night in the winter, the average work per day being at least twenty hours. In the dangerous powder-making sheds the lights are enclosed in specially designed copper reflectors, enamelled white inside, with tight-fitting plate-glass fronts. Each lamp is under separate control, and each circuit can be controlled by a switch in the machine-room. Every lamp and every circuit is also protected by a safety-plug, which melts in case of danger through excess of current; thus breaking the current, and removing all possible danger.

— The rainfall in San Diego, Cal., and also throughout southern California, is greater for the present season of 1883–84 than has ever been previously recorded. A total of 18.46 inches has fallen at San Diego, and as high as 60 inches have been reported from the back country. The rainfall for 1879–80 was 14.89 inches; 1880–81, 9.30 inches; 1881–82, 9.47 inches; and for 1882–83, only 4.91 inches.

— The Indians in Oregon are much disturbed by the constant settling of whites on lands which they have occupied, and which have enabled them to gain a living by horse-raising. They recently asked for a hearing for their grievances from the commander of the fort at Walla Walla, which was granted. They were told, however, that their only remedy was in taking the land as individuals, and not as members of a tribe. But as they have scruples about dealing in mother-earth, from which they all come, and to which they return, the prospect is at present that they will be finally driven from all land outside their reservation.

— Professor Ormond Stone, now of the University of Virginia, resigned the position of astronomer of the Cincinnati observatory in June, 1882; and upon his advice, his former assistant, Mr. Wilson, now astronomer *pro tempore*, has devoted himself chiefly, since that time, to the reduction of the miscellaneous observations which remained unpublished. No. 7 of the publications of the observatory, a pamphlet of 79 pages, contains those observations which pertain to comets, and is divided about equally between observations of cometary positions and physical observations. Previously to 1880 this observatory paid no attention to these bodies, the equatorial (Merz and Mahler, $11\frac{1}{4}$ inches aperture) being principally engaged with double-star observations. The former publications of this observatory (Nos. 1–6) relate entirely to discoveries and micrometrical measurements of double stars.

The observations of position were made after the usual manner, mostly with the filar, but sometimes with the ring-micrometer, and need no further mention here. The assumed co-ordinates of a hundred and fifty-four comparison-stars are given also. The physical observations, generally made just before or after the observations of position, consisted of sketches, measures, and notes on the appearance of the comets. Sketches of the heads of comets were made with the large equatorial, using a power of about a hundred diameters. The tail-sketches were made with the unassisted eye, and sometimes an opera-glass. All the stars visible in the vicinity of the comet were plotted upon the pencil-sketches as accurately as possible with the eye. The stars were afterward identified in Heis's *Atlas Coelestis*, and plotted to a scale three times that of the engravings. The position of the nucleus was then plotted, and the tail drawn in the same proportion, relatively to the stars, as on the original sketch. In the process of photo-engraving, the compiled sketches were reduced to one-third, so that the engravings are about the same size as the original sketches.

The theory and methods of discussion of tail-observations of comets, elaborated by Dr. Bredichin, director of the observatory of Moscow, have been followed by Mr. Wilson; and he summarizes that theory from *Copernicus* and the *Annales de l'observatoire de Moscou*.

The discussions of the notes on the several comets form a very interesting contribution to cometary astronomy. The plates accompanying the work contain about thirty drawings of comet (*b*) 1881, twelve of comet (*a*) 1882, and twenty of comet (*c*) 1882, commonly known as the great comet of that year; and they appear to have been reproduced in a manner worthy of the accuracy of the originals.

— In the French journal, *La ramie*, M. Pailleux calls attention to a Japanese plant named Kusu (Pueraria Thunbergeana), the roots of which contain starch, while the leaves and shoots are used as food. Its fibrous portions are adapted for use in the manufacture of cordage. It is a lofty and hardy plant, attaining within a year to the height of between twelve and twenty-five feet. It yields fruit, and grows upon the most unfruitful dry ground, where nothing else would thrive, provided there is a sufficiency of warmth. It requires no care, and can be propagated by seeds or by planting.

— The Chinese are beginning to adopt western chemical science, and a factory has recently been erected for the manufacture of sulphuric acid on a large scale. Two well-known chemical text-books — Malguttis' Elementary chemistry, and the Chemical analysis of Fresenius — have also been translated into Chinese, with the help of a great number of new characters, and adopted in the imperial colleges. His excellency Tong Kin Sing, the first minister, has taken the work under his immediate patronage, and written the preface for the first of these books.

SCIENCE.

FRIDAY, APRIL 25, 1884.

COMMENT AND CRITICISM.

THE National academy of sciences, which met at Washington last week, labors under a serious disadvantage in being able to meet but twice a year; more frequent meetings of a society whose membership extends over the entire country being impossible under present conditions. Notwithstanding this disadvantage, it is of the highest importance that the leading scientific workers of the country should form an organized body; and the academy seems to fulfil the objects of such an organization as well as any that could be devised. It is hampered by no rules that do not admit of being amended whenever it is found necessary so to do, and there is no limit upon the membership except what the academy may itself see fit to impose. The infrequency of its meetings does not prevent it from being always ready for action on any subject referred to it by congress, or any department of the government. The president of the academy can at any time appoint a committee of experts to investigate and report upon the questions submitted, and he has authority to accept the report of such a committee. At first sight, this system might seem to place too much power in the hands of the president and any committee he chooses to name; but, practically, the danger of this power being abused is no greater than in all human affairs. Important reports are submitted to the academy for approval whenever practicable; but even then the academy can seldom or never do better than accept the opinion of the experts who have investigated the subject. The varied applications of science are now so highly specialized, that conclusions depend more upon a minute examination of details, such as only a committee can enter upon, than upon general opinions.

The most important functions of the academy are those which grow out of its relations to the government. The liberal spirit which animates both congress and the executive departments in their dealings with scientific affairs is very apt to lead them into the support of scientific enterprises without any sufficient consideration of the conditions of success and of efficient and economical administration; and a careful consideration of each proposed undertaking by a committee of experts is what is wanted to insure the adoption of the best methods. Indeed, it is worthy of consideration, whether congress would not do well to adopt the principle that it would make no appropriation for a new scientific object unless the plan of operations were first submitted to and approved by the academy.

OLEOMARGARINE, suine, and all forms of imitated and adulterated butter, receive heroic treatment by the legislature of New York. A bill has passed the senate by a vote of twenty-five to four, and the assembly by ninety-nine to one, which absolutely prohibits the manufacture or sale of bogus butter within the state. Penalties in fines of from fifty to a hundred dollars are imposed for violations of the act; and a dairy commissioner, appointed by the governor, with a salary of three thousand dollars, is to be allowed twenty thousand dollars with which to enforce the statute. At this writing, the bill only awaits the signature of Gov. Cleveland to become a law, and go into effect the first day of June.

This action resulted from an order of the senate, to its committee on public health, to inquire into the adulteration of food and dairy products. Various agricultural organizations had previously pressed the matter upon the legislature; the State dairymen's association sending an active committee to Albany to look after it, and furnishing counsel for the senate

committee. The latter, with Senator Low of Orange county as chairman, made a vigorous campaign, gave public hearings at Albany and New York, aroused popular interest, and submitted an elaborate report. The investigation was extremely one-sided throughout, and the facts were absurdly exaggerated and distorted; as, for example, when it was seriously argued that the factory manipulation of butterine generated loathsome diseases among employees, and that the extending use of imitation-butter caused an increase in the death-rate of New-York City.

The main points brought out by the inquiry were these: that previous laws of restriction and regulation were ignored because no proper provision was made to execute them; that while the imitations and adulterations of butter were generally known where handled in the wholesale trade, and changed hands without deception, although often unmarked, these articles were almost uniformly fraudulently retailed as real butter; that farmers and merchants, including exporters, believed the production and sales of genuine dairy-products to be suffering from the frauds; that the later modes of manufacture were less cleanly and healthful than when oleomargarine was first made; that nitric acid and other objectionable substances were carelessly used in the newer processes; and that honest dairymen were being induced, under pressure of competition, to buy oleo-oil and 'neutral lard' (deodorized low-grade fats) to extend the quantity of home-made dairy-products.

Missouri is the only state which has, previous to New York, adopted the policy of prohibition as a cure for dairy frauds. The result will be watched with interest. Although under active management, supported by popular prejudice, this extreme legislation has been secured almost unopposed, there are those who doubt its wisdom, both as regards cheap food, and the true dairy interests of the great dairy state. The matter is also being agitated in New Jersey and Pennsylvania.

Attention was called in one of our previous numbers to the difficulty experienced by the signal-service in securing young men, well trained in meteorology, for scientific work in the central office at Washington, on account of the lack of adequate instruction on this subject in our universities. Signal-service note, no. ix., prepared by Mr. Frank Waldo, after a year's residence in Germany, on the study of meteorology in the higher schools of Germany, Switzerland, and Austria, shows how much more attention is there devoted to this growing subject, although in many universities or technical schools it is taught only in an elementary way, or not at all. Such names as Hann, Oberbeck, Simony, Sohncke, Supan, Thiesen, Zöppritz, appear on the list here given; all of these professors giving original lectures. The chief reason for this latter point is, we may suppose, because no text-book has appeared which fully represents the present attitude of the new meteorology. In the absence of any serious modern treatise, articles in scientific journals form the main source of the newer material not original with the instructor. Workers in this country may therefore congratulate themselves on the opportunity for technical publication and discussion now offered in the American meteorological journal lately announced.

New Jersey is in a fair way to be the first state in the Union provided with a good topographical map. About a year ago we described the two sheets of the northern part of the state then issued. The considerable progress achieved since then is now detailed in our notes, together with the plans for the future. Professor Cook, director of the geological survey of New Jersey, states, in his recent annual report, that the topographical sheets already published have been very generally approved, and are now in demand for the laying-out of water-supply and drainage works, roads and railroads. The work is one that New Jersey may well be proud of, and that other states must envy.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

'A singular optical phenomenon.'

THE 'singular optical phenomenon' described by 'F. J. S.' on p. 275 of the current volume of *Science* is a case of the familiar *watering* effect produced by superposed loose and regular fabrics, or by distant palings and lattice-works superposed by projection. We may find it convenient, in the following discussion, to refer to these by the general term of 'projection phenomena,' although the phrase does not seem to me to have much to recommend it except convenience.

I ought to say that this discussion is prompted by the letter by Professor LeConte in the last number of *Science;* for, if so skilled an experimenter could overlook the real explanation, it may safely be concluded that most readers have done so. Moreover, the phenomenon is one of a large and interesting class, of which I have never met any explanation, although, as we shall see, very simple considerations will lead us far towards a complete explanation of all.

For the sake of simplicity, we will begin by the consideration of two gratings of regular horizontal elements: the one nearer the observer, which we will call the first grating, is to be of alternating opaque and transparent strips; and the more distant one, or second grating, of white and black bands. We will also suppose, at first, that the eye is placed in a line passing through the middle of a dark band and an opaque strip, and that the aperture of the pupil is negligibly small. We may also conveniently assume that the angular widths of the elements of both gratings are so small that they are not separately evident to the eye, not only because such cases offer the most striking phenomena, but also because in them the meaning of the term 'apparent brightness,' which we shall use, is self-evident.

We will call the distances from the eye to the screens respectively d_1 and d_2; the breadths of the opaque and black intervals, b_1 and b_2; and, finally, the element of each grating (that is, the distance from the centre of one dark strip to the centre of the next), E_1 and E_2.

If B is the brightness of the white portion of the second grating, it is evident that the average brightness of the field, if the first grating were removed, would be

$$B\frac{E_2-b_2}{E_2}.$$

If, on the other hand, the first screen remained in place, and the black strips of the second should be replaced by white of brightness B, the field would appear of a brightness

$$B\frac{E_1-b_1}{E_1}.$$

As a first special case, let us suppose

$$\frac{E_1}{d_1}=\frac{E_2}{d_2}:$$

then, remembering the position of the eye, it is clear that each opaque bar would be centrally projected upon a dark strip of the second grating; and the brightness would be uniform, and equal to the less of the two expressions above.

For a second case, suppose

$$\frac{E_1}{d_1}=n\frac{E_2}{d_2},$$

n being any whole number: then every nth black strip would be centrally covered by a bar of the first grating. If $\frac{b_1}{d_1}$ is equal to or less than $\frac{b_2}{d_2}$, the brightness would be uniform, and equal to $B\frac{E_2-b_2}{E_2}$; but, if this limit of equality were surpassed, the average brightness would be

$$B\frac{nE_2-(n-1)\,b_2-b_1\frac{d_2}{d_1}}{nE_2},$$

and there would be regularly placed minima, unless the angle $\frac{nE_2}{d_2}$ were insensible to the eye.

The case of $n\frac{E_1}{d_1}=\frac{E_2}{d^2}$ is equally easy.

In all that follows, we will, in order to avoid too extensive discussion, regard n as equal to unity: by this limitation we sacrifice no interesting cases.

Suppose, now, the eye moved continuously up or down, parallel to the gratings. After a certain small displacement, depending upon the relation of $\frac{b_1}{d_1}$ to $\frac{b_2}{d_2}$, the brightness of the field would continuously diminish until it reached a minimum equal to

$$B\frac{E_2-b_2-b_1\frac{d_2}{d_1}}{E_2},$$

unless the numerator should be negative, when the minimum would be absolute. It would remain at this minimum for a certain time, depending upon the constants of the system, and then increase by exactly the same law as that of decrease, until after a displacement of the eye equal to $E_1\frac{d_2}{d_2-d_1}$, when it would recur to the same condition as at first.

As a final and more general case, let us suppose that

$$\frac{E_1}{d_1}=\frac{E_2+\delta}{d_2},$$

where δ is a small quantity, positive or negative. If we again suppose that the eye is so placed that a line drawn from it perpendicularly to the two gratings will pass centrally through dark bars in each, then a line drawn from the eye through the mth bar of the first grating will pass through a dark strip of the second, if $\frac{m\delta}{d_2}$ is a whole number. Let m be the *smallest* number which meets this condition: then a line drawn through any bar between the 1st and mth would meet some one of the conditions discussed in the last paragraph, as produced by a movement of the eye. Thus we see that the field would present horizontal maxima and minima of brightness, the angular position (θ) of the maxima being given by the equation

$$\theta=\text{tang}^{-1}N\frac{mE_1}{d_1}$$

where N is any whole number, positive or negative. The apparent distance apart of the maxima would be $\frac{mE_1}{d_1}$.

If the eye be moved so as to shift the apparent position of the central bar to the adjacent black strip on the second grating, the middle of the field would have undergone all the changes of phase which correspond to a change of tang θ from zero to $m\frac{E_1}{d_1}$; hence such a motion of the eye would appear to give

rise to a shifting of the whole series of maxima by this angle. The direction of apparent motion would be either with that of the eye, or opposite, according as δ is positive or negative. The displacement of the pupil necessary to bring about this change would be

$$E_2 \frac{d_1}{d_2 - d_1}.$$

If the relative motion of the periodic phenomenon and the first screen be regarded as a parallactic displacement, then we must suppose their relative distances from the eye inversely proportional to their apparent motions; i.e., as

$$\frac{m E_1}{d_1} \text{ to } \frac{E_2}{d_2 - d_1};$$

or, since $\frac{E_1}{d_1} = \frac{E_2}{d_2}$ nearly, as m to $\frac{d_2}{d_2 - d_1}$.

It was this apparent parallax which led 'F. J. S.' to suppose the phenomenon which he describes an image of the distant screen between himself and the first window.

If our gratings be complicated by the addition of equally spaced vertical bars, we shall see also, in general, a series of vertical bands giving maxima and minima along a horizontal direction. These will be separated by intervals

$$\frac{m' E_1'}{d_1};$$

and the ratio of their apparent angular motion to that of the first screen when the eye is moved equals

$$m' \text{ to } \frac{d_2}{d_2 - d_1},$$

where the letters marked with $'$ are defined by analogy.

A very interesting conclusion follows from the consideration that m and m' are wholly independent; the one depending on δ, and the other on δ'. Thus, we may have the horizontal bands moving in the same direction as the eye, and the vertical bands moving in the opposite direction, or *vice versa*: hence, if the displacement of the eye is neither horizontal nor vertical, the network which forms the projection phenomenon may seem to move in any direction, the only condition being that the horizontal and vertical components of the velocity are proportional, respectively, to m' and m; or, in other words, to the apparent width of the bands, divided by the corresponding element of the first grating.

In the case of gratings which are not plane, superposed by projection, as is the condition generally with doubled laces, veils, mosquito-bars, etc., — in short, in almost all cases of every-day observation, — both δ and δ', as well as the direction of the elements of the gratings, are functions of the distances from the central point of the field; but, as these are continuous functions, we can state several of the most important properties of the projection phenomena: viz., —

1°. The bands will be continuous and curved. 2°. If the eye be moved, the phenomenon will shift with an apparent velocity in any direction proportional to the width of the bands measured in that direction. 3°. The motion of a single band will, in general, be a motion of translation, combined with a motion of rotation. But the instantaneous centre of rotation cannot lie in a band; for in that case, according to the previous conclusion, that point being at rest, the band would there have no width, consequently could not exist. 4°. If a band forms a closed curve, a motion of the eye will necessarily produce a continuous change in the apparent magnitude of the ring; for a mere motion of translation would correspond to a momentary rotation about at least two points in the curve, which, according to the last principle, is impossible.

The properties described under the second and fourth heads above are those which more especially cause the projection phenomena to resemble those of watered silk; for the latter follow much the same law.

We will now consider the effect of the size of the pupil of the observing eye, which has hitherto been considered as a point. It is obvious that the image on the retina must be the sum of the projection images as seen from each point of the pupil: hence, if the pupil is not much greater than the space through which the point of view must be shifted in order to produce a complete change of phase (i.e., than $E_2 \frac{d_1}{d_2 - d_1}$), the phenomenon must be like that for an indefinitely small pupil, except that the discontinuity is less pronounced. This explains why, in fine networks, such as veils and mosquito-bars, the distance $d_2 - d_1$ between the fabrics must be small in order to produce the projection phenomena. In the case described by 'F. J. S.,' $E_2 = \frac{1}{2}$ inch, $d_1 = 10$ feet, and $d_2 = 40$ feet: consequently the expression indicating the limit which the diameter of the pupil must not greatly surpass is $\frac{1}{6}$ inch.

The effect of maladjustment of the eye would be to diminish still further the discontinuity of the phenomenon; but this would be carried so far as to destroy the periodicity, and thus obliterate the phenomenon, — not when an angular interval of $\frac{E_2}{d_2}$ at the distance d_2 becomes indistinguishable, as 'F. J. S.' seems to have expected, but only when an angular interval of $\frac{m E_1}{d_1}$ at the distance d_1 becomes indistinguishable.

The cases where n differs from unity offer no difficulties, but they are much less interesting. They exclude the case which has given rise to this discussion; for there E_1 equals $\frac{1}{8}$ inch, the other dimensions having been already quoted.

In what precedes, however, I have tacitly assumed that $\frac{\delta}{d_2}$ is always the reciprocal of a whole number. This may not be true. Suppose the value to lie between $\frac{1}{N}$ and $\frac{1}{N+1}$, where N is a whole number: then, if N is large, the solution above is accurate within the range of observation. If, on the contrary, the value of N is moderate, successive maxima will differ by a quantity which is itself periodic.

It will be observed that the second grating may be perfectly replaced by an image by reflection of the first. Frequent examples of this arrangement are seen in screens before closed windows or mirrors.

The general analytical solution of the whole class of phenomena produced by parallel rectangular gratings with indefinitely small pupil is easy; but the solution is so extremely general, that its reduction to special interesting cases requires even more writing than we have found necessary here. The only point worth dwelling upon here is, that the apparent variations in brightness, though periodic, are always discontinuous; but that every departure from the assumed geometrical conditions, such as are effected by diffraction, dimension of the pupil, and imperfect accommodation, tends to decrease the discontinuity.

C. S. HASTINGS.

Baltimore, April 11.

Rhythmic variation.

It is a general axiom in 'breeding' and in allied biological discussions, that 'like produces like;' and yet in nature, or under art, we have no instance we can use where like has produced an identical likeness. It rather seems that the practical expression should be the converse one, that 'variation produces variation;' for in nature we find variation the general fact, no animal and no plant producing offspring precisely similar to itself. Indeed, as the attribute of life is motion and but momentary equilibrium between internal and external forces, we may consider variation as an empirical law of nature, and as influenced by the law of rhythm, as outlined by Herbert Spencer, who says that rhythm results wherever there is a conflict of forces not in equilibrium.

This law of rhythm seems sufficient to explain, in part or in whole, some of the variations observed in species, and for which neither natural nor sexual selection can account. Given organisms under similar environment, and remote from selective opportunity, we must believe that variations must occur; and these variations must naturally become grouped about types under the action of heredity and some other general laws, giving through rhythmic action the appearance of progressive development.

Probably this law of rhythmic movement may explain the interesting variations which have originated species in certain protoplasmic organisms, as so well described by Professor Asa Gray (*Amer. journ. sc.*, April, 1884, 327), who says, —

"No exercise of 'natural selection' could produce the successive changes presented in the evolutionary history of the typical Orbitolites, from Cornospira to Spiroloculina, from Spiroloculina to Peneroplis, from Peneroplis to Orbiculina, from Orbiculina to the 'simple' forms of Orbitolites, and from the 'simple' to the 'complex' forms of the last-named type. And as all these earlier forms still flourish under conditions which (so far as can be ascertained) are precisely the same, there is no ground to believe that any one of them is better fitted to survive than another. They all imbibe their nourishment in the same mode, and no one type has more power of going in search of it than another. That they are all dependent on essentially the same conditions of temperature and depth of water, is shown by their occurrence in the same marine areas. That they all equally serve as food to larger marine animals, can scarcely be doubted; and it is hardly conceivable that any of their devourers would discriminate (for example) between the disks of a large O. marginalis, or middle-sized O. duplex, and a small O. complanata, which even the trained eye of the naturalist cannot distinguish without the assistance of a magnifying-glass."

E. LEWIS STURTEVANT.

Geneva, N.Y., April 12.

Rare Vermont birds.

In a list of birds given under this heading in No. 55 of *Science*, appeared the American avocet (Recurvirostra americana Gm.) and orange-crowned warbler (Helminthophaga celata Say, Bd.). It appears, these were admitted on mistaken evidence, and are not to be considered as Vermont birds.

FRANCIS H. HERRICK.

THE APRIL SESSION OF THE NATIONAL ACADEMY OF SCIENCES.

THE number of papers presented at the session of the National academy of sciences in Washington last week was less than usual, and, judging from the discussions, none were of commanding interest and importance. An unusual number of prominent members were absent from the meeting; and it also happened that the social re-unions which have usually accompanied the annual session were, from various accidental circumstances, omitted. It has long been a custom, if not an unwritten law, of the academy, to decline all social attentions which do not come either from members or officers of the academy, or from heads of government departments interested in its work.

An interesting feature of the meeting was a communication received from Mrs. J. Lawrence Smith, widow of the late lamented chemist of Louisville, proposing to give the sum of eight thousand dollars, which she had received from Harvard college by the sale of Professor Smith's collection of meteorites, to establish a memorial fund for the promotion of meteoric research. The academy will then have four considerable funds for the promotion of science, — the Bache, Draper, Watson, and Smith funds.

The following were some of the more interesting of the physical papers: —

It has long been a well-known result of theoretical mechanics, that the rotation of the earth causes a slight tendency in any southward-flowing river of the northern hemisphere to press towards its right bank; and various phenomena have been attributed to this, among others a supposed tendency of driftwood to accumulate on the right rather than on the left bank. It is, however, readily shown that this tendency could not produce this effect; and the general conclusion has been, that the only effect would be an imperceptible difference of level of the two sides of the river. The object of the first paper read — that of Mr. Gilbert, on the deflection of river-courses in consequence of terrestrial rotation — was to point out an indirect result of the forces in question, which had hitherto been overlooked, and which might produce observable results. He showed that the effect of terrestrial rotation is to increase the centrifugal force on those curves which deflect the river from the right towards the left, and to diminish the force in the opposite direction; the difference in the case of the Mississippi River being about one-tenth part of the whole.

In his paper on the origin of crystalline rocks, Dr. Sterry Hunt conceived that rocks, like gneiss and other felspathic, hornblendic, and quartzose aggregates, resulted from the action of water on the superficial and last congealed part of the earth's crust, through upward lixiviation. The separation of zeolites and quartz from basic rocks is a survival of this process of deposition from mineral springs,

whose action divided the primitive rock into a lower basic and an upper acidic portion. The author distinguishes this by the name of the crinitic hypothesis.

In continuation of the series of researches which he has been making upon solar and terrestrial radiation, Professor Langley presented a short paper on the character of the heat radiated from the soil. It is a commonly accepted opinion, that the atmosphere is less transparent to the invisible heat-rays of the sun than to the visible light-rays, and that the heat stored in the atmosphere is due to this cause. His researches had, however, shown, that, so far as solar radiation is concerned, this view was ill founded, since the solar rays of longest wave-length pass as freely through the atmosphere as the visible red rays. But, when the radiation from a metallic surface heated to the temperature of boiling water was measured, rays were found of a wave-length far exceeding any that had been measured in the solar spectrum. As it could not be considered probable that such rays were really wanting in the heat emitted by the sun, he reached the conclusion that they were absorbed by the atmosphere, which should therefore be regarded as opaque to such rays. This being the case, all or nearly all the heat radiated by the soil would be intercepted by the atmosphere; and thus we have the heat-storing effect to which the temperature of our globe is to be attributed. Incidentally Professor Langley expressed his entire dissent from the conclusion of Herschel and Ross respecting the heat radiated by the moon. The latter had attempted to differentiate the heat reflected by the moon from that radiated, and to determine the latter, and thus reach a conclusion respecting the temperature of the lunar surface. The conclusion of Professor Langley's researches was, that the heat radiated by the moon could no more penetrate our atmosphere, so as to be absorbed on the earth's surface, than it could penetrate the armor of a ship of war, and that its supposed measure must therefore be illusory. He also expressed the opinion, that the temperature of the moon under the influence of the full radiation of the sun, instead of being several hundred degrees Fahrenheit, as Herschel had supposed, was more likely very far below the lowest known on our globe.

Dr. Hilgard made a communication on the depth of the western part of the Atlantic Ocean and Gulf of Mexico with respect to the Gulf Stream. His remarks were illustrated by a model in relief, showing the configuration of the whole country east of the Mississippi River, and of the bottom of the Atlantic Ocean and Gulf of Mexico. The very slow rate at which the depth of the ocean diminished until the Gulf Stream was reached, and the rapidity with which it then shelved off, were very strikingly shown by the model. Dr. Hilgard also gave an account of the progress of the work of the coast-survey in connecting the Atlantic and Pacific coasts and the Gulf of Mexico by precise levellings. The work has been in charge of a single assistant, and has been carried 1,784 kilometres from New York, past St. Louis. The datum-point at St. Louis has been determined to be 126.91 metres above mean sea-level at Sandy Hook, with a probable error of 48 millimetres. By three sets of levellings, which have been made by different parties in the Mississippi valley, from St. Louis to the Gulf, and which are, in part, of unknown value, it would appear that the mean sea-level of the Gulf at New Orleans was one metre higher than that of the Atlantic Ocean at Sandy Hook, — a difference deemed probably greater than fact.

Mr. H. M. Paul of the naval observatory read a short paper on the Krakatoa atmospheric waves. He had made a copy of the curves of atmospheric pressure on the days in question, as registered at the signal-office in Washington, and reached conclusions similar to those of Gen. Strachey and others. He also showed that waves of the same kind had been recorded at other times on the register.

Several of the papers presented on the biological side were the direct result of the explorations of the U. S. fish-commission steamer Albatross. One of more than usual general interest was that of Prof. A. E. Verrill, who gave an account of some of the zoölogical results of the deep-sea dredgings between Cape Hatteras and Nova Scotia, using the model exhibited by Dr. Hilgard to illustrate his remarks. The number of additions to our fauna was surprising, including many new family and generic types in fishes, crustaceans, mollusks, echinoderms, and other of the lower invertebrates, and many whose nearest allies were inhabitants of distant seas. The dredgings were from two thousand to three thousand fathoms.

Dr. Gill and Mr. Ryder's paper on the Lyomeri exposed the characters of an extraordinary type of deep-sea teleost fishes, having, among other characteristics, no branchiostegal and pharyngeal, and only rudimentary branchial arches; an imperfectly ossified cranium; only two cephalic arches, — a maxillary and a suspensorial; no palatopterygoid and an imperfect scapular arch. The remarkable deviations

from the ordinary fish-type can be explained on teleological grounds. The enormous development of the jaws throws the branchial apparatus out of place, and entails its eventual degradation. The peculiar construction of the mouth, and opposability of the jaws, appear to be correlated with selection for food, which seems to consist principally of globigerinae and copepods, which are doubtless restrained from escape, with the water ejected from the mouth, by the structures functioning as pockets and whalebone.

Another paper, largely based on the work of the Albatross, was that of Dr. Gill on the ichthyological peculiarities of the Bassalian realm, as he has proposed to call the deep-sea region. His views, which are at direct variance from those of Dr. Günther, based on the study of the Challenger material, will be given in some detail in an early number of *Science*.

In his paper on mastodons, read by Dr. Gill, Prof. E. D. Cope claimed that ten species were known from North America, of which no less than eight flourished during the Puerco period.

Dr. J. S. Billings, through Major Powell, suggested a new method of studying crania by means of composite photography, and exhibited some very interesting prints taken in illustration, on each of which seven adults of the same race and sex were shown from in front, in profile, and from beneath. Sioux, Eskimo, and Hawaiian-Islanders were the races chosen; and the method seemed capable of wide application with good results.

President E. M. Gallaudet read a paper on the 'combined system' of teaching the deaf, which he illustrated by one of his pupils, who could answer questions put to him with considerable distinctness. The speaker was not, however, of opinion that the use of the manual system could be entirely dispensed with, and characterized as a fallacy the views supposed to be held by another school, — that because some deaf had been taught to speak by lip instruction, therefore all could be so taught. The system which Dr. Gallaudet prefers, he would probably consider an eclectic one, applying to each case the method best adapted to it.

The following gentlemen were elected members of the academy: Profs. E. S. Dana and Sydney I. Smith of Yale college, Gen. C. B. Comstock of the corps of engineers, Dr. W. K. Brooks of Johns Hopkins university, and Capt. C. E. Dutton of the U. S. geological survey.

The autumn session of the academy will be held in October, at Newport, R.I.

AN ARCTIC VESSEL AND HER EQUIPMENT.

A good portion of the science of navigation is devoted to the subject of safety. In navigation in the ice, that object is increased tenfold in importance, and overshadows all others. In the history of the different arctic voyages, whether for popular reading or for scientific report, this question of safety has generally been considered only so far as that particular voyage had any thing interesting or useful to suggest as a result of its own adventures. While it is not hoped in this article to add any thing to our previous stock of knowledge, still it is possible, that by bringing together a statement of various dangers and difficulties to be met, and the methods which have been employed to overcome them, its publication will aid in an understanding of this often talked of arctic voyaging.

The subject of ice-navigation embraces the construction of ships for this peculiar employment, or the altering for it of those that have seen less severe service; their management under the various combinations of ice-packs, ice-floes, icebergs, tides, storms, currents, and every obstacle of the frigid zone; their care and preservation in the ice during the arctic winter; and their liberation from this ice when the summer will allow them to begin again their experience as they prosecute their journey on or homewards.

I will not dwell upon such indubitable facts as the quality of the ship's material, which it is evident must be of the very best, be it wood or iron, or the almost equally apparent fact of the superiority of a vessel specially constructed for this purpose, by the hands of proper persons who have had experience in arctic navigation as well as naval construction, over the reconstructed merchantman or even stronger built man-of-war. The superiority of iron ships over those of wood no longer holds in the Arctic. The rapid conductive power of the former makes it almost impossible to keep an equable temperature without a thick inside coating of some non-conductor, besides the more rapid formation of frosts from condensed moistures along the outer sides of the bunks, causing serious diseases, and greatly aiding the propagation of that most terrible of all arctic scourges, the scurvy. The superior strength and endurance of iron over wood, in the usual accidents of the temperate and tropical seas, seem to be lost when the test comes in the shape of severe pressure from the ice; the elasticity of the wood allowing it to return to its original shape after an almost indefinite

number of nippings which are not sufficient to directly crush the vessel, while the same number of equal pressures on its iron companion become slowly accumulative, until it finally succumbs.

A wooden vessel, however, may be very properly plated with iron over the hull for some feet under water, to protect it from the grinding action of the 'ice-tongues,' which are formed by the unequal melting of the edges of large ice-cakes, which, projecting their huge submerged points often for a distance of twenty or thirty feet, become dangerous to a vessel compelled to thread narrow and tortuous channels and 'leads' in an open field of pack-ice, where the first intimation of their presence is a low, dull, groaning sound, and a swinging of the ship, probably a half-dozen points, despite the helmsman, or probably a perfect arrest as the helpless ship comes up broadside against the cake of ice, and with all sails thrown aback. 'Ice-tongues' which gradually shoal from a greater depth than that drawn by the vessel are not so dangerous as those not so deep, the latter acting like a ram in a collision. In case of a 'nip' or a pressure from ice on both sides, these same ice-tongues are to be earnestly prayed for, as their shoaling sides often aid a vessel in being lifted out of the water, when, in such a tremendous pressure, she could be saved in no other way. Therefore, when a 'nip' is inevitable in a narrow 'lead' constantly closing down on a vessel, this fact should be strongly borne in mind in selecting that point where the least damage will probably be done when the final collision comes. It would appear, therefore, that iron ships are inferior to their weaker but more elastic wooden compeers; and this is ably demonstrated by facts in the sad fate of the River Tay in 1868, in Baffin's Bay, and of the Swedish exploring-ship Sophia, in the north of Spitzbergen. In both instances these vessels sank under circumstances where good wooden vessels would probably have survived.

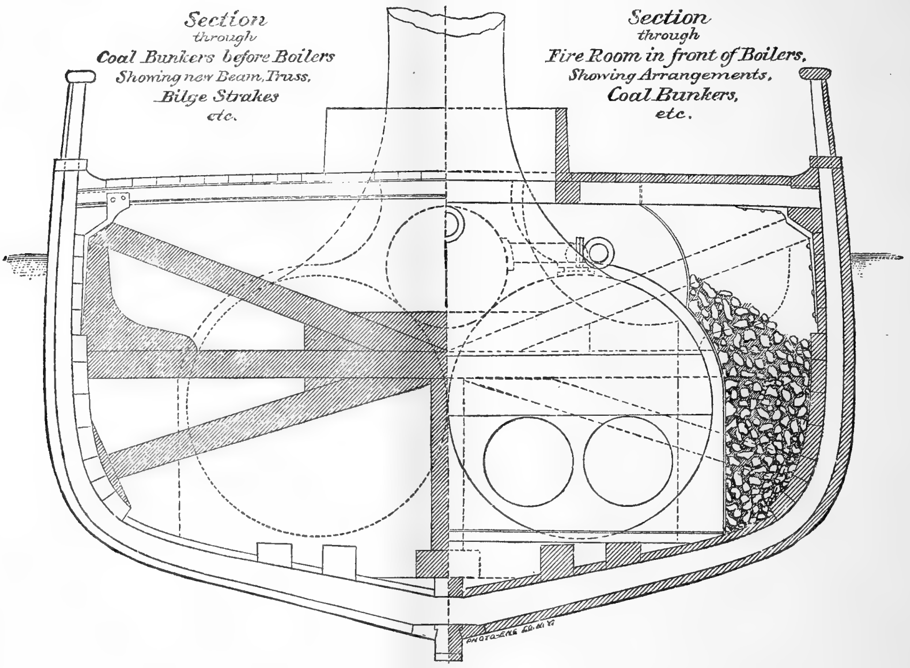


FIG. 1.—Cross-section of Jeannette.

I believe the limited experience with iron rigging in the arctic regions has been against it, except on short summer cruises with no intention of wintering. However, it is not a subject of much importance, unless the sails be alone depended on.

Coppering is of little or no use, and I have not been able to find any comments upon it by those who have used it. In such cases it was probably a part of the sheathing before the vessels were intended for arctic duty, as on the Erebus and Terror. The fact that most vessels are sheathed with two or three inches

of planking in their vulnerable parts for ice-navigation, makes the ordinary metal sheathing of but little importance. This wooden sheathing varies considerably in arctic vessels as to the parts of the ships that are plated, the thickness and amount, and kinds of hard or soft wood planking.

Having decided to build a wooden vessel, the shape of the hull is not a matter of indifference. The full, round ship, or, nautically speaking, a ship with full lines, is much more liable to be crushed by ice-pressure than one built with sharp lines; as fully illustrated in Koldeway's German expedition, when the Germania, built upon the latter principle, stood the ice-nip without very serious consequences during a heavy storm, while her companion the Hansa was crushed and sunk, she being modelled upon the former plan; and this, despite the fact that the Germania was the larger vessel, and therefore more liable to destruction than her lighter escort. This was also said to be the fault with the Jeannette, whose cross-section is shown in fig. 1, taken from Mrs. De Long's 'The voyage of the Jeannette.' Nothing less than an 'ice-tongue,' whose submerged edge would be below the point braced by the inclined beam at its foot, would have been of much use to save her in a 'nip' by the method of lifting already noticed.

These 'ice-tongues' are very much less frequent than most people might suppose from the constant use of the expression in this article. They are really very rare; at least, of such shape and size as those indicated. The edges of an ice-cake or an ice-floe may be of any shape consistent with unequal melting of its parts, and the 'tongue' is only one of the rare varieties. If very acute, it may be too weak to wedge up a boat, and may break off, as I saw in one instance, which, luckily, was not caused by a 'nip,' or the ship would have been immediately crushed. It is upon the relative position of these inequalities of the ice-edge fore and aft of a ship, that depends whether or not she will inevitably be crushed when two cakes or floes come together at her position during a heavy ice-pressure: therefore, the larger the ice-cakes in a pack, the better is her chance of escape.

The ease with which a ship can be lifted is, of course, a direct function of her size and weight. The size for an arctic exploring-vessel may vary, depending upon the service to which she may be put, and the time she is to be employed in polar seas; still, the general principle that a vessel should be as small as possible, compatible with the object in view, is a good one. The smaller and lighter the boat, the more easily is she raised by the squeezing floes; and the cases where this lifting of a vessel from the glacial vice, in one or two instances completely from her element, has been the salvation of her, are sufficiently numerous to be taken into account. Again: a small ship is more readily handled in the tortuous channels through which she is often compelled to thread her way while working in floes just sufficiently open to allow progress.

While arctic authorities agree upon the employment of small ships, the exact size in tons is seldom stated; but, in the few cases mentioned, about four hundred tons may be taken as the maximum limit. The superiority that a large vessel has over a smaller one in its greater momentum, when called upon to 'ram' the ice, so as to force a passage, is compensated by the fact, which experience has fully settled, that the large ship will succumb sooner to these severe and repeated shocks that she is thus compelled to bear. It should be added, that it is only when the floes are small, and the ice comparatively loose, that any ship, whatever may be her size, can 'ram' it with any fair prospect of effecting a passage. A steamer intended for 'ramming' the ice is always strengthened at the bows by 'dead-

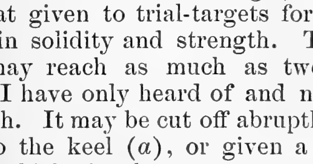


FIG. 2. — 'Deadwood' backing for bows.

wood,' or a solid wood backing (Fig. 2) not unlike that given to trial-targets for ordnance practice in solidity and strength. The depth of this may reach as much as twenty feet, although I have only heard of and never seen such depth. It may be cut off abruptly perpendicular to the keel (a), or given a parabolic flare (b), which, for the same amount of wood, is evidently the stronger for the various strains that the bow of an ice-vessel may be called upon to bear.

With a vessel thus provided, sometimes a triangular indentation of a thin floe may be 'rammed,' and the ice split by the wedge, the vessel burying herself in the crack; and then, when there is a large crew, their running in a body from port to starboard, and reverse, by rocking the vessel, has been known to increase the new 'lead,' and allow the vessel to back

out for further operations. When the wind is blowing vigorously, there are some disadvantages in 'ramming,' besides the condition of the pack caused by it. A vessel with the wind on the beam, and standing high out of water, and with considerable sailing-gear aloft, drifts faster than the pack, and, in backing out for a fresh start, may find the ice in the rear interfering with her backward movements; for a propeller must be very careful in all her retrograde actions.

This charging, 'ramming,' or pushing of ice by a vessel brings us to a consideration of the motive power most serviceable for ice-navigation, — steam or sails; for it is only by the former that charging can be made possible, except in those extremely attenuated packs where the headway of the sailing-craft is sufficient to carry her safely through, should she be compelled to strike a few glancing blows on isolated cakes. The use of steam may be laid down to be all-important, despite the fact that some few persons of no inconsiderable experience as arctic navigators still denounce the waste of room occupied by the steaming-machinery; the necessarily large amount of fuel to make it effective; and the anxiety imposed upon the commander regarding his propeller, which may break its blades, despite its protection of iron grating, and other derangements of machinery, that may here become extremely difficult, if not impossible, to repair. The first attempt to use steam in ice-navigation was with a paddle-wheel steamer, in 1829; and, as would be expected, it was the most worthless when the most needed. The propeller was first used on Sir John Franklin's ill-fated expedition in the Erebus and Terror, in 1845. It was worked by locomotive machinery; and how well it did its work, like a great deal of other information concerning that party, is wrapped in mystery. Certain it is, Sir John Franklin came nearer accomplishing his object than any of his predecessors; but whether due to his propellers, or to a favorable season, can only rest on conjecture. However, his propellers were not powerful enough to release him from his two-years' besetment in the ice-packs of Victoria Straits, unless the cause was due to a scarcity of coal.

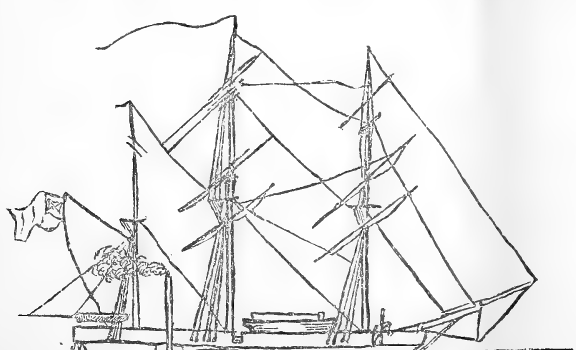


FIG. 3. — Sketch showing engines in Sir John Franklin's ships.

With the various improvements in propellers, especially in their protection by iron gratings and baskets, came their more universal use in arctic navigation; and at this date one seldom hears of an expedition to these waters not thoroughly fitted with this most essential auxiliary to a perfect success. By steam-power only can a vessel defy the ever variable winds of those regions. The Mallory propeller, or some modification of that form, will, I think, be found useful in threading narrow lanes through ice-packs. Certain it is that there is no place in the annals of navigation where a vessel is called upon to constantly make such short turns in such limited space as in ice-navigation. Of the steam-winch placed on the Jeannette's deck forward of the smoke-stack, capable of lifting the screw, unshipping the rudder, and warping the ship ahead, De Long's journal says, "Our steam-winch did good service, for we could easily snub the ship's head into a weak place when we did not have room to turn her with the helm."

Running before a breeze and with a current is said to be the most favorable condition that can be secured for a sailing-craft, more on account of the disjointed and open condition of the ice-pack that is usually produced by this state of affairs than the speed, which should always be lowered, sailer or steamer, if there is any danger of unnecessary collision with the ice. Even in this most favorable state, if she be running towards the throat of a funnel-shaped channel, she will more than probably encounter a gorged ice-pack at this point, barring her farther progress. A sailing-vessel caught in this predicament is in a very precarious condition. To the well-known obstacles of returning against wind and current, there is superadded the incoming ice, which will certainly add one or two, if not two or three, points to her leeway, in constantly attempting to weather the large ice-cakes and often equally dense and larger ice-packs with fruitless results. The time lost in wearing her around, or throwing her on the other tack when a channel, open one min-

ute, has closed in her front, makes it almost and often quite impossible to return: and the grinding, crushing pack soon builds up to her position, and encloses her under the most dangerous circumstances that can occur in ice-pressure, unless she can find an 'ice-dock' like that described by Dr. Kane; and even this, at any minute, is liable to be obliterated by an increase of wind, or a pressure due to the accumulation of ice or change of tide. This state of affairs is, I think, more than probably illustrated in the case of the besetment of Sir John Franklin's Erebus and Terror, in September, 1846, off Cape Felix, on King William's Land. Attempting to pass through Victoria Channel, whose southward-trending current is at this point greatly narrowed by the converging shores of Victoria Land on the west, and those of North Somerset, Boothia, and King William's Land on the east, his propellers worthless or his coal-supply short, either he must have encountered this ice-gorge so late in the year that his ships were almost immediately frozen in, or the summer's winds held him against or in the pack, as already indicated. The latter idea seems to me very reasonable; for during the time my party was on King William's Land, from the time the ice broke up in Victoria Channel on July 24, 1879, until the ice, newly forming, was sufficiently thick to stop a sailing-vessel (which was about the middle or latter part of September), I was forced to notice an almost continuous north-north-west veering to north-east wind, evidently caused by the warm rays of the almost never-setting summer's sun heating and rarifying the atmosphere over the vast snowless plains of upper British America, whose place is filled by the denser air chilled by the great ice-fields of the Arctic Ocean. That this Victoria Channel is navigable under very favorable and exceptional circumstances is shown by the fact that one of these two ships afterwards floated down or sailed through this narrow strait to near the mainland of America, some one hundred and fifty miles, manned by not more than four or five men.

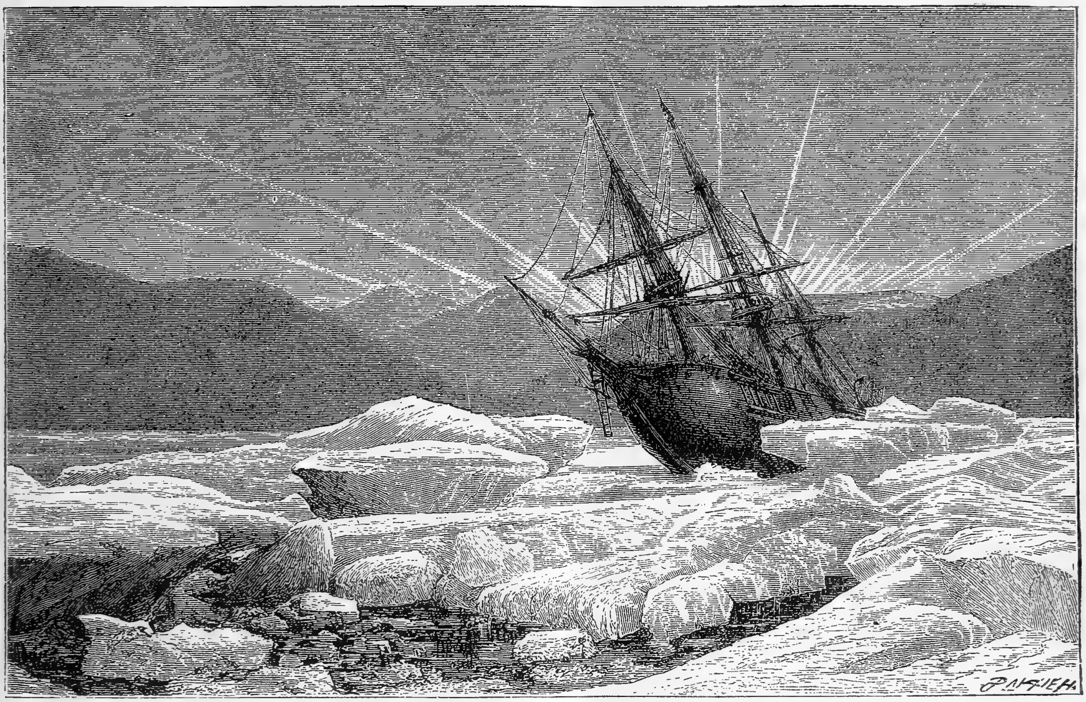


FIG. 4. — H.M.S. Alert forced on the land.

A steam-vessel can go into winter harbor much later than one with sails alone; and this is of no small importance, considering the short season during which navigation is at all practicable. This arises mostly from her superior advantages in 'charging' the newly forming ice of the early fall. The action of a sailing-vessel in this kind of ice is so well described by Sir Edward Parry, who had seen

five arctic expeditions, all in sailing-craft, that I transcribe his short description: —

"The formation of young ice upon the surface of the water is the circumstance which most decidedly begins to put a stop to the navigation of these seas, and warns the seaman that his season of active operations is nearly at an end. It is indeed scarcely possible to conceive the degree of hindrance occasioned by this impediment, trifling as it always appears before it is encountered. When the sheet has acquired a thickness of about half an inch, and is of considerable extent, a ship is liable to be stopped by it unless favored by a strong and free wind; and even when still retaining her way through the water at the rate of a mile an hour, her course is not always under the control of the helmsman, though assisted by the nicest attention to the action of the sails, but depends upon some accidental increase or decrease in the thickness of the sheet of ice, with which one bow or the other comes in contact. Nor is it possible in this situation for the boats to render their usual assistance by running out lines or otherwise; for, once having entered the young ice, they can only be propelled slowly through it by digging the oars and boat-hooks through it, at the same time breaking it across the bows, and by rolling the boat from side to side. After continuing this laborious work for some time with little good effect, and considerable damage to the planks and oars, a boat is often obliged to return the same way that she came, backing out in the canal thus formed to no purpose."

A sailing-vessel caught in this unfortunate state of the ice must immediately seek winter quarters in the nearest harbor; and if that be remote, and the wind unfavorable, or, rather, unless it be extremely favorable, the crews will be forced to cut a channel the entire distance for the helpless ship. This Parry was forced to do in 1819, near Melville Island, the channel cut being nearly three miles long. On the contrary, with steam-power, ice only half an inch thick is an insignificant obstacle; and a vessel thus equipped can steadily force her way through such a thin sheet, while even that proportion of a yard can easily be overcome by charging, requiring only well-strengthened bows.

Although good arctic authority has said that "the making fast to a floe should never be attempted except when every hope of navigating in the surrounding waters has been fruitless," and further adds, "As a principle, and so far as it is possible without the exhaustion of her powers, a ship in the ice should endeavor to be in constant motion, even though this entail many changes of her course and the temporary return to a position which had been abandoned" (Payer), still the latter suggestion, involving, as it may, for a great period of time, the consumption of coal, and the many cases where vessels with banked fires have with advantage fastened to floes with their ice-anchors, ready to escape almost at a moment's notice, makes these bits of advice not strictly essential for steamers, if they be properly harbored under the lee of the ice. With a sailing-vessel, this recourse becomes much more dangerous. The fastening to an iceberg is not altogether unattended with danger, and should only be resorted to when other means of safety are remote. The Polaris was justified, in such an instance, in seizing on to Providence Berg, although I have seen some contrary opinions expressed. A sailing-vessel should only do this when it becomes necessary to avoid drifting into a more perilous position.

Another advantage of steam over sail power alone is in the case of a calm with a strong tidal or other current setting towards an ice-pack or stranded iceberg, in waters so deep that anchors are of no avail; the salvation of the latter from possible severe injuries depending upon the relative power of the current, and the strength exerted by her small boats to tow her off, while the easy escape of the former is obvious. Also, in the early and late navigation of these waters, the sails are liable to become completely clogged with ice and sleet, rendering them, in extreme cases, impossible of manipulation. This state of affairs nearly proved fatal to the Griper (Capt. Lyon, R.N.) in September, 1824, in North Hudson's Bay, while attempting to battle with a terrible two-days' storm; the sleet forming over a foot thick on her decks, and proportionally over other parts of the vessel.

I should not have entered into so long a discussion on the seemingly palpable superiority of steam-power over that of sails, were it not for the fact that such a great proportion of the arctic expeditions are of a private nature, wherein the means of the liberal donor or donors cannot reach the increased expense of steam-machinery, fuel, and its accompanying charges; and those serving are willing to accept the situation rather than compromise the expedition altogether. There are also a few, as I have already hinted, who are opposed to steam-power from the great room it sacrifices, and its liability to incur greater risks than it can escape from if at all unfortunate. There is also a medium class, who, acknowledging the waste of room as the only detriment to be found in steam, believe that this power should be represented by machinery of the cheapest class, which can be abandoned and its room made useful at any time that it fails to subserve some good purpose.

It may be laid down as a good rule, that all sailing-vessels should have some 'square' rig to subserve active movements in the ice. Sailer or steamer, the pipes for pumping should be much more capacious than usual, and there

should be a system of them reaching to every part of the vessel; for the pumps may be needed the most when the vessel is careened on her beam, or at some unusual angle fore and aft.

If possible, a tender should accompany the exploring-vessel proper, especially if she be a steamer, whose stores of coal and other articles are to be transferred when the ice becomes dangerous for such a craft, presumably not strengthened to combat with that element.

FREDERICK SCHWATKA.

ON THE FUNDAMENTAL THEORY OF DYNAMIC GEOLOGY.

MANY lines of inductive research lead to the conclusion that the interior of the earth is in a fluid condition, and that the solid shell is comparatively very thin, but variable in its thickness from district to district, and in the same district from time to time geologically. A crust twenty-five miles in thickness at a maximum, and very much thinner at a minimum, best explains geologic phenomena. If we consider this crust to be made up of units defined at the upper surface by districts of some magnitude, it seems necessary to regard it as existing in a state of floating equilibrium; so that, if some portion of the rocky material is taken from any such district, it rises, and the district on which it is deposited subsides. In case material is transferred for a very short distance, appreciable displacement may not result, the local structural rigidity being sufficient to withstand, or largely withstand, the stress. But if the short transferrence is across the line of a fault, from the upraised to the thrown side, the facts seem to show that the upheaved side continues to rise by reason of unloading, and the thrown side to subside by reason of increased load.

The rigidity of the crust of the earth arising from the molecular cohesion of the solid state is greatly modified by mechanical structure. The crust is composed of geologic formations of diverse origin, diversely arranged. The formations are broken into great blocks by great fault and flexure planes, in many cases doubtless extending quite through the crust. It is also fractured in multitudinous ways, and the crevices filled with vein matter. Again: each block or segment of a faulted formation is divided into small fragments by stratum planes, joints, schist planes, and slaty cleavage. The rigidity of each minute fragment is due to the molecular cohesion of solidity, but the general rigidity of the crust is dependent on mechanical structure. The fragments of which the crust of the earth is composed are exceedingly minute when compared with geologic formations, and they appear relatively as but grains of sand when compared with the whole crust of the earth.

This fragmental character of the crust is exhibited at the surface, and to the greatest depths to which observation has extended; and, so far as it depends upon the great faults, it must extend quite through the crust. There may be and probably is a zone beneath, so nearly fluid by reason of temperature and pressure, that fractures are less easily generated and more easily repaired, but the rigidity of the crust is not increased thereby.

The solidity of the crust of the earth is limited by temperature and pressure under conditions of chemical constitution and hydration, and is further limited by the conditions of its mechanical structure.

If vertical stress be applied to a point on the surface of the earth, the strain is propagated laterally by the condition of rigidity, but not indefinitely, as this rigidity speedily vanishes in the presence of the enormous forces involved in the weight of the crust itself, and in the great bodies of matter that are unloaded and loaded at the surface. The distance to which the strain extends is greatly lessened by the fact that the crust is not a continuous solid by cohesion, but preserves continuous rigidity in a very imperfect way by mechanical structure alone.

If the crust of the earth were practically homogeneous in the specific gravity of its materials, its static equilibrium would not permit the existence of any great elevations at the surface; but to the conclusion of a general equilibrium, geologists and geodesists are alike converging; and, if true, it necessitates the further conclusion that the crust, and perhaps to some extent the underlying fluid matter, is of varying density from region to region. This conclusion follows from a consideration of the inequalities of altitude existing in the earth's surface: and, since they are ever changing from district to district, — as one subsides and another rises, — contraction and expansion must occur. The necessity for the hypothesis of contraction and expansion is not obviated by the hypothesis of a fluid interior, nor is the latter rendered unnecessary by the former.

There is a constant lateral transferrence of material at the surface by rains, rivers, and marine currents; there is a constant vertical transferrence of material by displacement; there is a constant transferrence of material

from beneath to the surface by extravasation; and geologists postulate a constant transferrence of material beneath by subterranean flow, thus completing the cycle of transferrences.

But transferrence of material laterally and vertically does not serve completely to explain all the history of geologic movement. Another hypothesis is yet necessary; and this exists in the postulate of ever-changing density, arising from the following sources: first, changes in density due to chemical action, especially as exhibited in hydration; second, changes in density due to solidification from the melted state, and to liquefaction from the solid state; third, changes in density due to pressure and to relief from pressure. A consideration of many geologic facts has suggested to the writer that it may be possible, that, when the rigidity of the solid state is overcome by pressure, the rate of condensation due to added pressure is increased at that critical point; or, stated in another way, that the passage of rocks from the fluid state induced by pressure, to the solid state by relief from pressure, is marked by a sudden expansion. Should experiments hereafter give warrant to this conjecture, the chain of conditions necessary to the explanation of dynamic geology would seem to be complete.

Early in the history of geologic research, a contraction of the earth, due to the loss of heat, was postulated to explain the deformations of the crust. This loss of heat occurs in two ways, — by conduction, and by convection from the interior to the surface. The convection is accomplished by the heating of subterranean waters, and their escape as hot water and steam from the multitudinous hot-springs and geysers of the world, by the steam discharged in large quantities from volcanoes, and by the lavas which come to the surface to be cooled. By this method of convection, cooling progresses at a high rate; for the lavas even of quaternary times are of vast extent, and the lavas of all geologic history are correspondingly vast in amount. How cooling by convection is quantitatively related to cooling by conduction cannot be stated with our present knowledge; but, when all of this cooling is considered, the rate of condensation is insufficient to explain the known displacement — it is necessary to resort to other agencies.

For the fundamental theory of geologic dynamics we have as conditions, first, a fluid interior of great specific gravity, in part due to compression; second, a solid crust of irregular thickness, not continuous by molecular cohesion, but composed of small fragments mechanically arranged, and permeated by water from above; and, third, an aqueous fluid and an atmospheric gas in motion over the crust.

The agencies of change may be considered as primary and secondary. The primary agencies are, first, general secular cooling by conduction and convection; second, the heat of the sun setting in motion the air and water at the surface; third, the astronomic agencies that produce stresses. The secondary agencies are, first, local heating and local cooling; second, local loading and unloading, having an augmented effect at the critical point of solidity; third, chemical reactions arising from changes of temperature, pressure, and hydration; fourth, the expansion of water into steam by internal and local heating.

The changes wrought are, first, general secular contraction; second, transferrence of material horizontally at the surface by aqueous agencies, and in the interior of the earth by flow, and vertically by subsidence and upheaval, and from within to the surface by extravasation; third, change in the chemical and lithical constitution of rocks, as seen in various forms of metamorphism; fourth, local lateral compression of formations, exhibited in plication and implication, and local stretching, exhibited in certain parts of flexures.

Conjointly and severally, the conditions, agencies, and changes thus enumerated seem to furnish a fundamental geologic theory, in harmony with and explanatory of the multifarious facts discovered in geologic research. Geologists widely accept the several parts of the theory save one; namely, that which assumes that the solid state is a critical condition of volume. The general theory enunciated is modified by a multiplicity of minor conditions, agencies, and changes, to expound which a voluminous treatise on geology would be necessary.

The correlation and interdependence discovered to exist between volcanism, seismism, displacement, surface degradation, sedimentation, and metamorphism, furnish important evidence in favor of the general theory. So far as research has progressed, regions of great and frequent displacement are found to be regions of great degradation and sedimentation, of great extravasation and seismism, and of great metamorphism; while regions of small displacement are regions of small degradation and sedimentation, of small extravasation and seismism, and, so far as known, of small metamorphism. The evidences of correlation are exhibited in many and diverse ways.

The agencies of change enumerated in the above theory are interdependent, so that the

increase or diminution of one results in the increase or diminution of all. If the agencies of the first order — i.e., secular cooling, heating of the sun, and astronomic stresses — be neglected, the other agencies are interdependent in such a manner that there is a tendency secularly to establish an equilibrium; and doubtless such an equilibrium would be established in a period not of great length considered geologically. But the agencies of the first order continuously destroy the static equilibrium, and, conjoined with the others, they produce the sequence of changes discovered in geologic history.

The rate of internal cooling is manifestly diminishing, and physicists incline to the opinion that the heating due to the sun is diminishing. From this stand-point, then, the rate of change in geologic history is secularly diminishing. On the other hand, the secondary agencies of change increase in efficiency by reason of increased heterogeneity in the structure of the crust. From the irregularities of the upper surface, and those probably existing at the lower, as suggested by many facts, the crust is heterogeneous in thickness, and doubtless is becoming more so. It also becomes more and more heterogeneous in constitution by the progressing differentiation of its parts, exhibited in the diversification of geologic formations, density, temperature, conductivity, hydration, and chemical and lithical constitution. This internal heterogeneity renders the crust more sensitive to external agencies of change, so that a smaller amount of primary change serves to unlock a given amount of secondary change. At the present stage of geologic research the facts are not sufficient to establish the quantitative relation between the diminished rate of change from the primary agencies and the increased rate of change from the secondary agencies. It is therefore impossible to predicate any variation in the rate of change from the close of archaean time to the present.

J. W. Powell.

EVOLUTION OF THE DECAPOD ZOEA.

Principles applicable to adults are often equally applicable to larvae. In the discussion of natural selection most writers have confined themselves to adult animals and their reaction upon environment. There is no reason, however, why the principle should not be extended to include larval forms; and, indeed, to a slight extent this has already been done. Weismann's 'Theory of descent' proceeds upon this line, and indicates some of the important results which may arise from such research. Crustacean larvae offer particularly good opportunity for work in this direction. They are abundant, are easily obtained, and readily studied. They present great varieties of form, which are frequently not in any degree related to the adult characteristics. Indeed, crustacean larvae seem almost like a distinct group of animals, and may be studied as such, with the extra advantage that they are highly variable, and undergo rapid metamorphosis. Some of the possibilities of such research may be seen by a short consideration of the different forms of decapod zoea.

To make the subject clear, it will be necessary to give a brief description of three types of decapod larvae, confining ourselves, however, only to such points as particularly concern us here. The first is the type, which is undoubtedly the oldest, known as the protozoea. It is a comparatively rare form, being found in a few macruran species (Peneus, Lucifer, Euphausia). Fig. 1 represents such a larva. As far as concerns us, the peculiarities are these: the long body consists of a large cephalothorax, a more or less complete thorax, and an abdomen. The important point is, that all of the regions of the body are represented. When viewed from above, the part of the body composed of thorax and abdomen is seen to be very slender and weak, and to extend for a long distance backwards. A second important point is the method of locomotion: unlike all other forms, the antennae, instead of being sensory organs, are used in locomotion. They are large, and covered with swimming-hairs, which convert them into paddles; and, by moving them to and fro, the protozoea slowly propels itself by a series of jerks through the water. The telson is a third important feature: it is small, being in our figure no broader than the abdomen; it is usually forked, and carries a number of long spines (typically seven, though the number varies); it is not a swimming-organ, — a point of particular interest. One other feature must be mentioned, — the usual though not universal absence of protective spines.

A second type is that of the ordinary macruran zoea; e.g., the larva of the common shrimp. Such a zoea is represented in fig. 2. Here we find a number of changes. First we see that only two regions of the body are present, the cephalothorax and the abdomen, the thorax being unrepresented. The cephalothorax is not very different from that of the protozoea. The abdomen is, however, very different: it is distinctly divided into segments, all of which are well developed; it is tolerably thick, and is a much more powerful structure than the corresponding part of the protozoea. The muscular and usually the nervous system is well developed. In short, the abdomen is much more perfect than that of fig. 1. The locomotion of this zoea is entirely different from that of the protozoea. It does not use its antennae for moving, but propels itself vigorously with powerful strokes of its abdomen, after the manner of the lobster: at least, this is its motion when trying to escape danger; and that is all that concerns us. In correlation with this changed locomotion, the antennae have altered their form, and are now true sense-organs. On the other hand, the telson has become broadened into a flat

swimming-organ. It is much broader than the rest of the abdomen, and is used as a paddle to augment the effects of the powerful strokes of the abdomen.

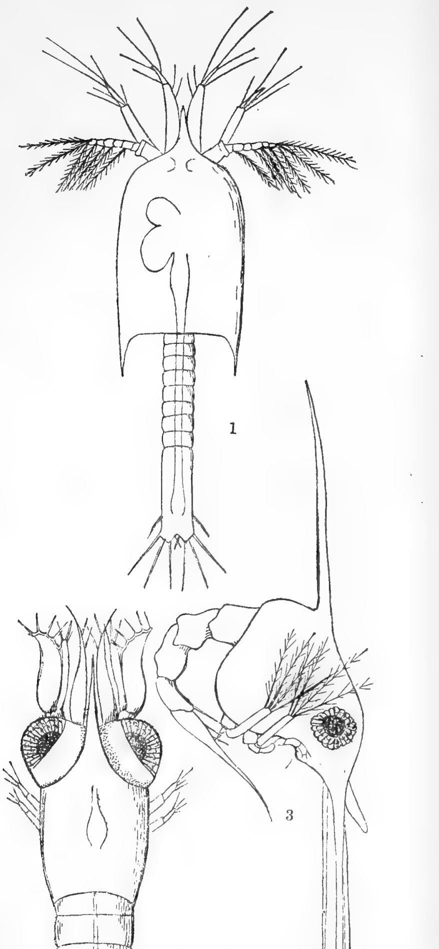


FIG. 1.—Protozoea of Lucifer (after Brooks). FIG. 2.—Zoea of Gebixi. FIG. 3.—Zoea of Panopeus. FIG. 4.—Telson of Panopeus zoea.

It still retains a number of spines, but they are usually quite small.

A third type is the zoea of the ordinary crab. Fig. 3 is such a zoea. Here we see a number of striking peculiarities. As in the shrimp zoea, we find no middle body; i.e., the thorax is absent. The abdomen is quite small, and always occupies a characteristic position. Instead of being stretched out behind the body, as in the shrimp zoea, it is bent under the cephalothorax, as in the figure. Still another mode of locomotion is here found. It is true that occasionally it uses its tail; but its ordinary locomotion is neither with antennae nor abdomen, but by means of its first two pairs of maxillipeds. These are very long, and carry large numbers of swimming-hairs, and serve as oars, with which the zoea paddles itself along. Its motion, while swifter than that of the protozoea, is not so vigorous as that of the shrimp. The tail has become modified into a form halfway between the tails of the other two larvae described. It is somewhat broadened, and probably has a slight motor function; but its chief use is protection (fig. 4). The most noticeable feature is the very remarkable cephalothorax. This is of enormous comparative size, entirely covering the body when the abdomen is flexed. It is further armed with a number (usually four) of long spines, which project in different directions, and are strong and sharp. No one can be in doubt as to the use of this arrangement. The large cephalothorax, with its resisting spines, serves as a protective case for the more delicate organs within; and, further, when the abdomen is flexed, the spines of the peculiar telson are placed in such a position as to give additional protection, being then directed forwards.

Now, is there any connection between these three forms, and is it possible to discover any explanation for their peculiarities? In the first place, comparative embryology shows good reasons for believing that the first type, protozoea, is the oldest, and that the others are derived from this form. The evidence cannot be here deduced, but may be found by referring to Claus, Brooks, or Balfour. Assuming, then, this to be the case, the question resolves itself into the simpler one, what caused the protozoea to undergo changes which converted it into the remarkable zoea form?

A simple experiment, easily performed by any one at the seashore, suggests an answer. The experiment is simply to endeavor to catch a specimen of each of these types of larvae with a moderately small dipping-tube. It will be noticed that all of the larvae seem to have a dread of the suction which is produced by the tube; and all will swim away from it, unless it be too strong. It will be further seen that it is next to impossible to catch the shrimp zoea. He darts away with the vigorous strokes of his tail, and, unless the fisherman is very quick, he is gone. Some of the crab zoeas will be easily caught; but they will be seen, upon examination, to have doubled themselves up into as compact a mass as possible, with all their spines projecting, and consequently in position to offer the greatest defence against enemies. Other crab zoeas will be found not so easily caught. If the zoea fished for be of the species figured, or, still better, be the larva of Porcellana, and the dipping-tube be small, it will be found impossible to catch it. The long spines project so far in different directions, that the

larva cannot enter the tube. Finally the protozoea will be easily caught: it swims slowly, and cannot escape the tube; nor does it present projecting spines which prevent its entrance into a small orifice.

This simple experiment teaches us four things: 1°. The dread of suction exhibited by all forms indicates that their chief enemies are small animals, largely, perhaps, fishes which swallow them in their widely-opened mouth; 2°. The behavior of the macruran zoea shows evidently, that, in its struggle for existence, it relies for its protection upon its power of flight, and this gives us immediately a hint as to the meaning of the broad tail; 3°. The crab zoeas rely for their protection, not upon flight, but upon the efficacy of their defensive armor, either as an actual defence, whose resistance baffles the jaws of the fish, or as an apparatus which prevents their entering the mouth of a small enemy (this consideration immediately explains the use of the excessively long spines in Panopeus and Porcellana, which seem to be such encumbrances to the freedom of the larva); 4°. The protozoea seems to possess none of these means for protection; and, indeed, in every respect the protozoea seems ill protected. Its slow, hesitating motion, its long weak abdomen, its long antennae with their numerous swimming-hairs, — all render it easily entangled by rubbish, and easily caught by any enemy.

Taking all of these points into consideration, we get suggestions as to a possible explanation of the remarkable differences between the crab and the shrimp zoea, — differences which seem difficult to understand, since the Brachyura and Macrura are evidently so nearly related. All decapod larvae are freely swimming animals, gaining their own living by an active search for food: they are therefore subjected to a struggle for existence precisely similar to that of adult animals. The principle of natural selection will be as potent to select and modify them as it is in selecting and modifying adults. If, therefore, we assume the protozoea as an original form, we must expect to find it in many cases highly modified, and must expect in most larvae to find, not a protozoea, but a greatly different form, and one better adapted for the struggle for existence. Nor must we be surprised if the embryologist comes to the conclusion that the modified larval stages do not represent stages of ancestral history.

That the protozoea larva is not well adapted for a struggle with numerous enemies is evident to any one who observes how easily it is captured. Assuming that this is the early larval form, we should not expect, from what we know of the workings of nature, that such an evidently weak form would be preserved, except in isolated cases. To adapt such a larva to a more effective struggle, there are three methods: the larvae may be largely increased in numbers, which would, of course, increase the chance of the species for survival; or they may develop powers of flight, which will enable them to escape their enemies; or the larvae may develop some sort of defensive armor, which will enable them passively to resist all ordinary attacks. Abundant examples of each of these methods may be found in almost any group of the animal kingdom, but probably no better instances than the larvae in question; and this is all the more interesting, since it shows that some of the principles affecting adults also in a similar way have their influence on larvae. With these points in mind, it is possible to explain all of the important differences between the protozoea and the two zoea types.

What explanation can we find for the shortened body? Two explanations for this can be found, both of which probably had their influence. The possession of such a long, weak, almost functionless hind-body as is found in the protozoea is certainly calculated to render its possessor a more easy prey to enemies than it would be were the body more compact. The shortening may therefore be simply a protective measure. Or a second principle has probably had even more influence. There is good reason for believing that the amount of energy of a developing animal is limited, and, if expended in one direction, cannot be employed in a second. If, for example, a child over-develops its brain, its body is sure to suffer. Now, this principle has had a similar effect in our larvae. In the protozoea the energy of development is evenly distributed to all parts of the body. The result is, that we find here a larva with almost all of the body present, but in a low state of development: the larva is consequently comparatively weak. If, however, the development of a part of the body should be postponed, the parts which did develop could reach a greater state of perfection, since the whole energy of development could be directly turned toward their perfection. In all existing zoeas the development of the thorax has been thus postponed. The zoeas are found, therefore, to be much more vigorous than the protozoeas, their muscular and nervous system is better developed, and they are in all respects more fitted for an active struggle for existence; and this applies equally well to the macruran or the crab zoea, and will assist in accounting for the absence of a thorax in the two forms, — a point which seemed a great difficulty to Balfour.

In other respects the crab and the shrimp zoea have taken two different lines. The macruran type has become modified for its struggle by acquiring great powers of flight: we find its body, therefore, long and slim; but, unlike the protozoea, it is very powerful, has well-developed muscles, and a broad, paddle-like tail, which, with the assistance of the powerful abdomen, forms an effective organ of flight. Every thing which might impede its motion has disappeared. The antennae are small, and the other appendages are such as to present no hinderances. The whole body has become adapted to its swift motion.

On the other hand, the crab zoea has taken a different line, and has developed, instead of a power of flight, a defensive armor. Its cephalothorax has enlarged, has become strong, and has developed a number of defensive spines, whose use has already been noticed. Its tail, not particularly needed for swimming, has not developed into a broad plate, but has become an augmentation of the defensive armor by the form and position of its spines. Some species have carried this line of development still farther,

and are provided with enormously long spines, many times the length of the body, which effectually prevent their being swallowed by small animals. The development of the spinous protection would seem to be correlated with the absence of a swimming-tail. Some species (Pinnotheres, Tatuira) which do not possess any of these spines show a tendency toward a modification of the telson, which has in these cases become quite broad and flat.

We may assume, then, that at one time the decapods, or the stem from which they arose, universally possessed a larval stage somewhat similar to the form known as a protozoea. As the struggle for existence became more and more severe among the Crustacea, modifications arose which took two directions. The adults became changed; and there arose in this way the different types which we know as Anomura, Brachyura, and Macrura. But at the same time natural selection had its influence upon the free larvae quite independent of its influence upon the adult. The larvae, therefore, also became slowly modified for their own protection; and from the protozoea arose the zoea types, with their infinite variety. It is quite evident that these changes may take place in the larvae without materially affecting the adult, for the circumstances bringing them about influence the larvae alone. Still it is probable that habits and form of the adult may have some influence upon the general shape of the larvae. The larva must eventually transform itself into the adult; and the more nearly it approaches the adult form, the less radical will be the change. We can therefore understand why the zoea of the walking animal, such as the crab, would develop protective apparatus, while the zoea of the rapidly-swimming Macrura would acquire organs of flight. We have therefore an explanation of the two facts, that the larvae of the greater groups exhibit a certain unity, while within a given genus the different species may widely vary. H. W. CONN.

THE EXPLOSIONS ON THE UNDERGROUND RAILWAYS OF LONDON.

THE explosion of Feb. 25, at the Victoria station, London, lends interest to the official report of Col. Majendie, on the results of an investigation of the circumstances attending the explosion near the Praed Street station, on the 30th of October last, and the one between Charing Cross and Westminster stations. The first explosion occurred in a tunnel about a hundred and thirty-eight feet distant from the station, as the 7.52 P.M. train was passing. The damage in the tunnel consisted of a vertical crater in the wall about twelve by thirteen inches, and four to six inches deep. Immediately below this crater, and extending about fifteen inches along the wall, was a horizontal crater about six inches deep, partly in the ballast, and partly in the brick footing of the tunnel. The flinty ballast in this crater was considerably splintered, and the brick footing pulverized. A two-inch iron gas-pipe ran along the wall at a height of ten inches. A length of this, measuring fourteen feet, was blown away, one end being much torn and twisted, and the whole piece bent into the form of a bow. At a distance of fifteen inches from the wall, and parallel with it, was an iron switch-rod, consisting of an inch and a quarter gas-pipe, supported on iron rollers at the level of the rails, from which it was distant two feet nine inches, the rollers being fixed on a wooden plank laid on the ballast. This board had about four feet of its length blown to splinters, and a large piece thrown upon the rail, and some of the wheels of the train passed over it. A length of the switch-rod measuring about two feet, and corresponding exactly with the portion of the gas-pipe which sustained the maximum injury, was blown out, the central part of this detached portion being split up and torn. This piece of switch-rod also bore marks of the wheels upon it. A telegraph cable, running along the wall at the height of eight feet and a half, was cut by the explosion. The walls of the tunnel were scored somewhat by the sharp *débris* blown against them, and the end of a sleeper opposite the crater, but partially protected by the ballast in which it was embedded, had a number of pieces of splintered stone driven deeply into it. The rails were entirely uninjured.

The injury to the passing train was confined principally to the last two carriages of the six composing the train. In these the greater part of the glass was broken into small fragments. Panels and partitions were shattered, the roofs and floors disturbed, the foot-boards broken, and the carriages seemed to be completely wrecked, yet no part of the framing or running-gear was injured. The gas throughout the train was extinguished, yet the apparatus was found to be uninjured. It is interesting to note, that the injury to the train was not confined to the side upon which the explosion took place, but extended also to the opposite side; and in the case of one carriage the damage was most marked on that side. Sixty-two persons were injured by cuts and contusions from the pieces of glass and *débris*, and, in one or two cases, by fracture of the drum of the ear and by severe shocks. Five of the injured were confined in the hospital for a considerable time. The breaking of the glass and putting out of the gas occurred on the surface, at the openings of the tunnel, for a distance of three hundred and fifty feet.

The second explosion, which occurred almost simultaneously with the first, took place at a point two hundred and forty-one yards from Charing Cross, and four hundred and eighty-eight yards from Westminster. As it occurred opposite a bay, the only damage done was the breaking of glass, and the extinction of the gas in both stations; the injuring of the telegraph and telephone wires for about sixty yards; the formation of a crater in the ballast, measuring about three by four inches, and one inch deep; and the 'pitting' of the walls of the tunnel, on the side of the explosion for some little distance to the right and left of the crater, and on the opposite side for a somewhat greater distance. The rails were entirely uninjured; but the ends of two sleepers, close to the point where the explosion occurred, sustained some injury.

Three hypotheses were suggested as to the nature of the explosive; viz., coal-gas, gunpowder, and dynamite. The fact that all the gas apparatus was found intact disposed of the first. The absence of all residue, and the extremely local and brusque action of the explosive, testified unmistakably to the use of an agent possessing greater detonative energy than gunpowder, while these properties are characteristic of dynamite. The finding of a piece of Bickford safety-fuze and fragments of copper, presumably from a detonator, strengthened this belief. Accepting this theory, experiments were made by Col. Majendie, together with Professor Abel and Dr. Dupré, to determine the amount of dynamite necessary to produce the observed effects, the switch-rod and gas-pipe from the Praed Street tunnel being used in similar positions to the charge which they bore there; and it was found that two pounds of ordinary dynamite would be sufficient, if properly detonated. The circumstances surrounding the explosions, however, indicated that a larger amount — probably five pounds — had been used, but that a portion had burned without explosion.

The means used for inducing the explosion was probably a suitable fuze of such a length as would burn for the desired time. This was then attached to a detonating-cap, and the latter inserted in a zinc case containing the dynamite. The assassin then boarded a passing train, and, lighting the fuze, threw the contrivance from the window, the fuze being timed to explode the cartridge under the train following. In the case of the Praed Street train the explosion was premature, and exploded under the train in which the assassin was. In the second case the explosion occurred at the time designed, but the train for which it was intended was late. In one minute more the train would have reached the spot, and the result would have been more serious.

UNIFICATION OF TIME.

A PART of the minutes of the session of the International geodetic association held in Rome last October, embracing the resolutions and discussions concerning an international prime meridian and system of expressing time, has been published. The resolutions have already appeared, but the discussions are now made public. Delegates were present from Bavaria, Belgium, France, Italy, Holland, Norway, Austria, Prussia, Roumania, Russia, Switzerland, Spain, United States, and Great Britain, and the almanacs were represented by Foerster, Loewy, and Pujazon.

The French delegates alone seemed to be somewhat opposed to the project; and their arguments, singularly enough, were not altogether unlike those that are so commonly urged against the adoption of the metrical system of weights and measures in this country.

Mr. Faye admitted the 'practical and undeniable need of a universal system of time;' but he would regret to see the suppression of all the nautical almanacs except that of England as a result of adopting the meridian of Greenwich, because 'these publications fed the sacred fire of astronomy.' "Still," said he, "the French government may be found more accessible to the proposal, if it be brought to the conviction that the reform would be advantageous from the point of view of general civilization;" which we may interpret as meaning, "if England will adopt the metric system in return." Professor Foerster thought it a strange phenomenon to see scientific men more narrowly nationalistic upon scientific questions than the nations and governments themselves. He considered it wicked to multiply repetitions of substantially the same calculations of ephemerides in the different countries merely to 'feed the sacred flame of astronomy;' or, in other words, to find support for computers.

Col. Perrier urged that the adoption of a distant meridian would be found extremely inconvenient in topographical maps; but Dr. Hirsch replied, that the meridian of Greenwich would hardly be more unfavorable than that of Paris for the eastern parts of France; and Helmholtz pointed out, that Germany, which had during a long period used the meridian of Ferro, had experienced no inconvenience from its being so distant.

Mr. Yvon Villarceau held, that any reform of the system of reckoning longitudes and time should be accompanied by a decimal division of the circle and of the day. But the idea of sweeping away the division of the day into twenty-four hours met with no favor; though the conference consented to a resolution expressing the 'incontestible advantages of a decimal division,' not of the circle, but of the 'quadrant of the circle, in extensive calculations.'

Mr. Loewy, the director of the *Connaissance des temps*, was more decidedly hostile to the change than any other delegate. He thought its advantages slight, its inconveniences considerable; and he could not consent to changing the usage of centuries in the arrangement of an ephemeris, without the most conclusive reasons. Professor Foerster in reply, holding the *Connaissance des temps* for 1884 in his hand, showed the great simplifications which would result from the change, and added, that Loewy himself had, in his direction of that ephemeris, been one of the most radical of innovators, and had certainly modified the arrangement far more than the proposed reform would do.

Notwithstanding the objections of the French members, some of whom voted against single resolutions, when the question was put, whether the body of resolutions should be adopted as a whole, it was carried unanimously, Loewy alone not voting. A very gratifying degree of accord may therefore be said to have been reached. Mr. Christie, the astronomer royal, declared his personal sympathy with the resolution expressing the hope that Great Britain might enter into the metre treaty, while explaining that he was not authorized by his government to encourage that hope. After the adoption of the resolutions, Gen. Cutts, the delegate of the coast survey and of the American government, which, it will be remem-

bered, has invited a diplomatic conference to be held in Washington upon this subject next year, addressed the meeting as follows: —

"Now that the important questions submitted to our deliberations have received, as I hope, their final solution, and that an agreement due to the merit of the cause has been reached, I ought, before the convention separates, to declare that the government and the learned societies of the United States are inspired in this matter, as almost all my eminent colleagues are aware, first, with the necessity of the change, and secondly, and more especially, with the desire of favoring the interests of science as well as those of commerce by land and sea.

"On the one hand, the civil day, as it now exists, has been preserved; on the other, for scientific and commercial reasons of high importance, a prime meridian and a zero of time, applicable to all nations, have been introduced. These decisions open a new era, which will be more and more appreciated, as the progress of nations, of international relations, and of science, — which knows no latitude nor longitude, — shall bring to light, in their assured development, all the advantages of the new system.

"About ten days ago the great railway-companies of the United States and Canada, operating 161,000 kilometres of lines, adopted the Greenwich meridian as the origin of time. I consequently think that I may express the hope that all the governments represented at the seventh conference of the Geodetic association will accept, on the recommendation of this conference, the invitation of the United States to send delegates to the international congress which is to be held next year at Washington, with the effect of resolving the question of the unification of longitudes and of time, and probably of proclaiming the great reform as an accomplished fact."

The mode of reckoning time proposed by the Geodetic association is substantially to use Greenwich mean solar time with the astronomical day. This is, perhaps, not absolutely inconsistent with the continuance of the system now in use in this country, of using Greenwich minutes and seconds with the most convenient hour, — a plan substantially the same as that first propounded by Professor Benjamin Peirce at the very beginning of the agitation for a new system. The geodetic congress assures us, that while there is nothing impractical in Greenwich time, pure and simple, the adoption of the time of the nearest whole hour from Greenwich is absolutely out of the question, because it would force people to get up and go to bed at unseemly or inconvenient hours. Indeed, their language would seem to imply that apparent as distinguished from mean time is imperatively required. "We do not, of course, wish," they say, "to suppress local time in common life, for that is necessarily and absolutely ruled by the *apparent* course of the sun: we do not dream of forcing the population of certain countries to rise at noon, nor of forcing others to dine at midnight." For people accustomed to regulate their actions by the striking of the church-clock, the change of time is certainly something more than a mere turning-round of the dial of the time-piece; and the European populations do go by the striking of bells much more than ours, no doubt. Nevertheless, the coming congress must be impressed by the eagerness with which our new system has been almost universally adopted, and even forced by the people upon the authorities. It is, perhaps, not surprising that it has been the scientific men, the theoretical men, who have been the last to judge the change to be practicable.

THE ORGANISMS OF THE AIR.

Les organismes vivants de l'atmosphère. Par M. P. MIGUEL, chef du service micrographique à l'observatoire de Montsouris. Paris, *Gauthier-Villars*, 1883. 8 + 310 p. 8°.

So much that has been written on the subject of the bacteria is merely a recapitulation of what has already been done, or a presentation of results based upon insufficient observations, that it is a pleasure to find a work filled with careful investigations carried out on an extensive scale.

The book before us contains no new or startling discoveries, but rather gives an almost mathematical proof of certain generally received ideas on the distribution of the microbia, and serves conclusively to refute certain errors which have been widely accepted.

The facts have been obtained by a daily analysis of the air taken in the Parc de Montsouris, near Paris. For the sake of comparison, air has also been taken from the centre of the city, the hospitals, and sewers.

After a brief historical sketch of the subject, comes a description of the organic and inorganic particles which have been deposited from the air, and which can be distinguished by aid of the microscope. Among the most interesting of the inorganic constituents are minute fragments of meteoric iron, which can be collected by passing a magnet over the dust, and of which Mr. Tissandier has made a special study. From the organic world are found vessels and bits of plants, as well as the cast-off shells of infusoria and their eggs, as proved by cultivation.

In order to study the particles suspended in the air itself, they must first be collected by aspirating a given quantity over a thin glass covered with glycerine, and then carefully examining the deposit. The cells thus obtained can be roughly divided, for purposes of classification, into four classes: —

1. Grains of starch.
2. Inert pollen of phanerogams, and the zoospores of unknown algae and cryptogams.
3. Spores of cryptogams and zoospores capable of producing a perfectly determinate alga, lichen, or other fungus.
4. Entire vegetables, usually unicellular plants, among which are to be noticed the green algae, the conidia, the yeasts, the *débris* of confervoids, diatoms, etc.

The starch comes mostly from the manufactures, but also from natural sources.

The pollen is never found germinating in the

air, however humid this may be. It is most abundant in spring and summer, and almost disappears during the autumn and winter. During the summer it exists to the number of from five thousand to ten thousand in every cubic metre of the atmosphere.

The spores of the cryptogams and algae appear during the damp months of April and May, and reach their greatest numbers in the latter part of June. They persist during the summer, and fall off during the autumn, to become as rare in winter as the pollen. The number varies from seven thousand in a cubic metre in December, to thirty-five thousand in summer. Fluctuations are found dependent upon damp or dry weather, the action of which, however, differs with the time of year. During a cold and wet period in winter, the spores sink to their minimum, while during the dry time the air is greatly enriched, but chiefly by old spores. In the summer, on the contrary, during damp days, the fructifications of the cryptogams are everywhere distributed in abundance.

> "The average of the spores collected by the aeroscope is about fourteen thousand per cubic metre. These figures are not excessive, and it is to be hoped that they will settle the contradictory opinions in this regard which have been expressed during the past twenty years. They will go to confirm in their ideas the partisans of the germ-theory, and will show to the few defenders of spontaneous generation how useless it is to invoke the doctrine of heterogenesis to explain the appearance of the mucidines in the liquids and on the substances fitted to maintain their life."

From an etiological and hygienic point of view, it does not seem that such diverse spores, introduced into the economy at the rate of thirty thousand a day, or one hundred million a year, are absolutely innocuous. The development of soor in the mouths of infants and in the respiratory tract of the dying show that the fungi also belong to parasites ready to invade the human organism when there is presented a point of feeble resistance.

The analysis of the air taken from the sewers showed about the same amount of organized material, with the exception of the almost entire absence of starch.

The remainder of the book is devoted to a study of the bacteria present in the air. This is the part which will naturally be of the greatest interest, from the relations which these minute organisms bear to disease and to the processes of putrefaction and fermentation.

Chapter iii. is devoted to a statement of the experiments of Pasteur and others, proving conclusively the existence of germs in the air, which alone are responsible for changes in the liquids into which they fall, and thus setting at rest the question of 'spontaneous generation.'

The classification of the bacteria receives a valuable contribution as the result of long and carefully conducted experiments. The author is convinced of the immutability of the species, but shows that they are capable of great variations under different conditions, and that without great watchfulness 'species' can be easily multiplied. The genera which are usually recognized, and which he accepts, are Micrococcus, Bacterium, Bacillus, Vibrio, and spiral Microbia. Even these genera cannot always be distinguished apart with certainty by their form alone. The characters which serve to differentiate them are briefly as follows: Micrococci and Bacteria never produce spores, Bacilli do; Micrococci are immovable, Bacteria are movable; Vibrios and Spirilla have an undulated or twisted form.

The methods of obtaining the spores from the air, and the sterilization and preparation of the liquids proper for their development, are the subject of the next chapter. This, as all other parts of the work, shows the results of infinite care and patience. National prejudice is, perhaps, the reason why the solidified meat-extracts and blood-serum have not been employed for the cultivation of the spores. But it is perhaps fortunate for the progress of science that such prejudices exist, as each method is developed to its greatest extent, and the exact value of the one can be controlled by the other. The liquid nutritive material has certainly received a most thorough trial in the hands of Mr. Miguel, and the results obtained by its use are not to be thrown lightly to one side. There are infinite sources of error when experimenting with the 'infinitely small;' and the precautions which have been found necessary from these extended observations should caution those observers who have only limited means at their command against hasty generalization. One of the most important safeguards is the proper 'firing' of the flasks which are to receive the culture. Experience has shown that they should be heated during four hours at 200° C.; and then, after having been charged with the 'bouillon,' they should stand for two months at 35° C. in a constant temperature apparatus. At the end of that time those which have retained their limpidity are regarded as sterile, and ready to be sown.

In order to obtain the number of spores distributed in the atmosphere, equal amounts of air are drawn over these sterilized solutions, and are then allowed to germinate at a constant

temperature of 35° C. If five or six groups of experiments are made in the same day and place, the results are almost identical, provided that the force and direction of the wind are constant, and, above all, if the air has not been purified by rain or snow. From this, the equal distribution of spores is proved, and not that they are in so-called 'clouds,' as has been maintained by Tyndall.

Signs of germination may appear within twenty-four hours; but it is usually from the second to fourth day that the greatest number of flasks are altered. From this time there is a rapid decrease until the thirtieth day, after which any alteration rarely takes place. The growth is manifest to the unaided eye in three different ways:—

1°. The liquid preserves its clearness, but a more or less voluminous deposit occurs at the lower part.

2°. The liquid is uniformly clouded at first, and then a veil arises, or a deposit is formed.

3°. The liquid remains transparent, but little isolated white clouds of silky mycelium appear, which can invade the entire fluid. These are usually fungous growths, but there are several filamentous microbia which can give rise to the same appearance.

In the flasks which are altered by these aerian spores, there rarely is perceived that nauseating cadaveric odor of intense putrefaction, produced by inoculating a drop of water from a sewer or even from the Seine. The bacteria of the air are only feeble and superficial putrefactors, and rarely cause a profound decomposition of the liquids into which they are introduced. It is necessary to banish from the mind the idea that we live literally besieged by organisms always ready to sow putrefaction on the mucous tract of our economies. The inhabitants of the country, more privileged in this respect than the dwellers in the city, hardly introduce into their lungs, in the course of a day, one germ of putrid fermentation.

The degree of alterability of the nutritive liquid should always be taken into account in experiments; and numerous investigations were made on this point. From these it appeared that an infusion of hay was the least susceptible of alteration, while neutral beef-bouillon, with the addition of one per cent of salt, was the most so. Normal urine held a middle place. These had been sterilized by boiling for two hours at 110° C. Contrary to general expectation, egg-albumen, diluted with water and sterilized by filtration through plaster, was found to be almost as resistant as the infusion of hay.

In order to cultivate the bacteria in a state of purity, a drop of one cultivation is transferred to another sterilized flask on the point of a 'fired' platinum needle. The danger of infection from the air, during the time the flasks are opened to permit the transfer, is very much less than is generally supposed. By computation, the chances are only as 1 to 1,500.

The results of the daily examination of the air at Montsouris during three years showed that bacteria and their spores were more abundant during hot weather than cool, and were inversely proportional to the degree of moisture. The direction of the wind was also of consequence, that which had traversed Paris being richer than that coming from over the country.

In respect to the seasons, the greatest number of germs were found during the autumn, then followed summer and spring, and lastly came winter, as the following table shows:—

Autumn,	121	spores per cubic metre of air.
Summer,	92	" " " " " "
Spring,	73	" " " " " "
Winter,	53	" " " " " "
Or a mean of	84	" " " " " "

The germs which thus find their way into the air are either carried there when dry, or are taken up with fine particles of water by the wind: they never pass off with the insensible evaporation of a fluid. A series of ingenious experiments with the condensations from putrefying liquids and substances proved the truth of this assertion.

The comparative analysis of the air taken from the streets near the centre of Paris showed that it was nine or ten times richer in schizophytes than that from the Montsouris Park.

In regard to the relation of the bacteria in the air, and the occurrence of epidemics of disease, the fact was observed, that, at the time when there was a comparative increase of deaths from zymotic disease, there was an unusually large number of germs in the air. As it is impossible at present to distinguish harmless from pathogenic microbia, and as the inoculation of cultures from atmospheric spores gave nearly negative results, the author wisely does not lay great stress upon this coincidence.

The interiors of houses were next made the subject of investigation. It was found, that, in a room which was perfectly still and undisturbed, there were 27 microbia to the cubic metre, against 97 in the air outside. The number in the same space in the author's laboratory was found to be 215 in 1880, 348 in 1881, and 550 in 1882. In an ordinary bed-chamber

in Paris, regarded as sufficiently clean, there was found, in the spring of 1882, 3,830, and, in the winter of 1882, 6,500; giving a mean of 5,260 to the cubic metre. A comparison with the air of a room used for a study in the observatory at Montsouris showed, for the spring of 1882, 270, and, for the winter of 1882, 380; giving a mean of 325 to the cubic metre. From this it at once appears that the air of the house in Paris was sixteen times as impure as that at Montsouris. The decrease in the number of germs from winter to spring is the reverse of what is observed out of doors, and is to be attributed to the more thorough ventilation during the warm months.

The same relation was found in the air from hospitals, except that the numbers were very much higher; varying from 4,500 in summer, to 24,000 in winter, per cubic metre. The micrococci were found to be most abundant here; every hundred germs furnishing, on an average, ninety-one against five bacteria and four bacilli. The inoculation of these, however, was without result.

The air and water from the sewers gave interesting results. A cubic metre of the former furnished from 800 to 900 microbes, while a litre of water taken at the point where it was discharged gave 80,000,000. In this relation it was found that a litre of water condensed from the atmosphere held about 900, a litre of rain-water 64,000, a litre of the Seine at Bercy 4,800,000, while, after the river had traversed Paris, a litre was found to contain 12,800,000. From this it can be understood how easily stagnant water of a sewer can putrefy, and how essential it is that there should always be a current flowing to prevent this. In the air of sewers it is the bacteria proper which abound, but they were without effect when inoculated in animals.

In the ordinary dust of houses it was estimated, after careful weighing and cultivation, that each gram contains about 750,000 spores. A sufficient number of analyses of the soil have not been made as yet, but those made give an average of from 800,000 to 1,000,000 for each gram of earth. In the deeper layers the bacilli preponderate over all other forms, while on the surface the micrococci are most abundant.

Antiseptic substances are last considered; and these are regarded as acting in two ways, — first by destroying the bacteria already in activity, and, secondly, by preventing the germination of spores.

Of such substances, oxygenated water (H_2O_2) was found to be the most powerful, then solution of corrosive sublimate and nitrate of silver. After these come a long list of less efficacious ones. The only compounds which were capable of destroying germs in their dry state by means of the vapor given off were bromine, chlorine, hydrochloric and hyponitric acids.

Such is a brief summary of the principal points touched upon in this book. It is not quite so clearly and concisely written as might be wished; but it is a valuable contribution to science, and must serve as a model for any one who undertakes work in this direction. A careful perusal of the book itself is certainly to be recommended to all interested in the subject.

MINOR BOOK NOTICES.

Outlines of chemistry for agricultural colleges, public and private schools, and individual learners. By N. B. Webster. New York, *Clark & Maynard*, 1883. (Practical science series.) 8+144 p. 24°.

This book seems somewhat out of place in a practical series, inasmuch as it consists chiefly of a collection of definitions and brief statements of common facts.

The experimental side of the subject is almost wholly neglected, or, at best, is passed over with brief allusions. To the student who is receiving instruction by lectures, the work might be of some service as a partial relief in taking notes, or as a book of reference, though it is too limited in detail to be of general use in this direction; but, as a text-book in a systematic course of instruction in elementary chemistry, it must fall short of the author's intention.

The electric light in our homes. By Robert Hammond. New York, *Worthington*, 1884. 12+188 p., illustr. 8°.

This is a special pleading for the incandescent electric light, delivered by Mr. Hammond in the towns of England as he travelled, in the hope of awakening the English people to the fearful condition of their homes at present, on account of the harmful effects of the products of gas consumption. In the opening, Mr. Hammond is very careful to first heat his audience over the gas-burners, then drench them with the condensed steam, and finally sprinkle them here and there with little specks of soot. After bringing his hearers into this unpleasant condition, a bright, clean, and cool incandescent electric light is held before their eyes till they fully appreciate its beauties. A short return is made to the drenching and warming process to make sure of any laggards, and the conditions of success of an electric-light system are explained. The story is well told

throughout, if one does not object to the fact, evident on every page, that the author has something to sell.

Patents on inventions: a quarterly patent-law review. H. Connett and A. C. Frazer, editors. Vol. i. New York, *Burke, Frazer, & Connett*, 1884. 12+214+12 p. 12°.

This is a collection of short essays on points of interest to inventors. These essays are principally written by the members of the firm of Burke, Frazer, & Connett, patent solicitors, in the intervals which their practice allowed. The articles are generally well written; but to some extent the smack of the advertisement clings to them, although none close with the advice to call on Messrs. Burke, Frazer, & Co., for a solution of the difficulties discussed. Throughout, the beauties of patents are upheld, and the *ignis fatuus* of a valuable patent is made as alluring as possible.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Field-work in the division of the Pacific. — In addition to the office-work of this division, carried on during the winter at San Francisco, field-work has also been prosecuted, especially since the 1st of January. During February, Mr. George F. Becker, geologist in charge, studied the surface-geology of the area lying between Mount St. Helena and Knoxville, in Napa and Lake counties, Cal., — a region that had previously been mapped by Mr. Hoffmann, topographer, and in which Mr. Turner spent some time, especially in January of this year. The mines of this district have been made the especial subject of study by Mr. Becker; and they prove to be of very considerable interest, lying, as they do, between a highly metamorphic area and one of unaltered sedimentary rocks, which is also marked by limited basaltic eruptions. The structure of Mount St. Helena has also been partially examined. During January, also, Mr. Hoffmann's field-work for the map of the New Idria district was completed for the illustration of Mr. Becker's monograph on the quicksilver deposits.

Map of Mount Shasta. — Mr. Gilbert Thompson has just completed a sketch-map, on a large scale, of Mount Shasta. It includes about seventeen square miles, and shows beautifully the glaciers and moraines of the mountain. As already noted in *Science*, Mr. Thompson has recognized some seven glaciers on the upper slopes of Shasta. On this map five of them are named as follows: the 'Whitney' glacier is on the north-west side, lying to the eastward of the volcanic crater (Shastina) that forms so prominent a feature of the north-west spur as seen from the valley below. It extends two or three miles from the summit toward the north-west, with a width in most places of less than a quarter of a mile. This is the glacier seen and explored in 1870 by Mr. Clarence King. The next glacier, as one proceeds eastward, is the 'Bulam' (or great) glacier, which extends to the northward or north-westward about a mile and a half. It is nearly a half-mile in width, and at its head appears to be connected with the 'Hotlum' (or steep rock) glacier, which lies next to it on the north-east slope of the mountain. The latter is broad, being almost a mile across, and reaching only about a mile and a half from the summit. On the eastern side of the peak is the Win-tún glacier (so named from the tribal designation of the Indians of the vicinity). It is nearly two miles long, with an average width of about half a mile. On the south-east slope is the Kon-wa-ki-ton (or Mud Creek) glacier, which, until Mr. Thompson described it, was unknown, although many of those who have climbed the peak since 1854 must have passed close by it. It is smaller than the others, having a length of only a half-mile. Its width is about a quarter of a mile. Mr. Thompson has furnished very full notes of these glaciers to Mr. I. C. Russell, by whom they will be published in the reports of the survey.

On another map being prepared by Mr. Thompson, Mount Shasta and the surrounding country are shown on a smaller scale than in the above-mentioned map; and the isolation of Mount Shasta is well shown. It forms no part of any mountain range; and the highest land within a radius of forty-five miles from its summit is Mount Eddy, which is fifteen miles distant, and is at least six thousand feet lower.

Ice-banners. — In Tyndall's 'Forms of water' is an illustration representing what he terms 'cloud-banners,' which are formed by a current of warm air, charged with moisture, passing a high and sharp mountain point, when, meeting with a colder atmosphere, it is condensed, and forms a visible cloud, the appearance of which has some resemblance to a banner. On Oct. 18, 1882, Mr. Gilbert Thompson ascended Lassen's 'Butte' (or Peak), in California, which has an altitude of 10,500 feet above sea-level; and on Oct. 12, 1883, he made the ascent of Mount Shasta, which rises to the altitude of 14,511 feet, some seventy miles farther to the north-west. On the summits of these peaks, and on both occasions just after a storm, Mr. Thompson observed what he terms 'ice-banners.' The iron signal-post on Mount Shasta, which rises sixteen feet above the summit, had the appearance often seen in trees, posts, etc., after severe snow-storms, when the flying snow is impacted against them by the wind, except that in this case the projection was just reversed, and lay from the wind. On the signal-post the 'banner' projected

nearly four feet at the top, becoming narrower towards the base. Mr. Thompson has also observed the same phenomenon on sharp rocks and sticks. Ice-banners are evidently formed from the vapor of passing clouds; and an observer favorably situated might watch their formation and growth. He thinks that possibly the base of a cloud-banner might be found to be an ice-banner.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American society of civil engineers.

April 16. — A paper was read by Hamilton Smith, jun., upon the temperature of water at various depths in lakes and oceans. The results of observations upon bodies of water in California, in the eastern states, and in Switzerland, were collated, and also the temperatures obtained in deep-sea soundings; all of which show that very slight variations in temperature occur at great depths, and also that great variations in surface-temperature affect the deeper waters only after a long interval, and that even in comparatively shallow reservoirs there is great uniformity in temperature, at even moderate depths, as compared with the variations in its surface.

Brookville society of natural history, Indiana.

April 8. — A. W. Butler presented a paper upon some explorations among the ruins of San Juan Teotihuacan, near the City of Mexico, illustrated by maps of that region, showing its topography. He described the appearance of the pyramids, the 'House of the sun,' and the 'House of the moon,' and gave the results of his investigations of the manner of their construction, and the excavations near them. A description of the so-called 'Micoatl,' 'Path of the dead,' and its relation to the 'House of the moon,' were given. In conclusion, he mentioned a large sacrificial stone found near the 'House of the moon,' which he illustrated by drawings of the front and top. —— Edward Hughes read a short paper upon the rats of Franklin county. —— A. W. Butler gave a short paper on the tornado of March 25, which he illustrated by maps, showing its course through the eastern part of Franklin county (Indiana), and the destruction it caused at Scipio, Ind.

Torrey botanical club, New York.

April 8. — Mr. Arthur Hollick read a paper upon autumn forms of the genus Viola. While engaged in studying the cleistogamous flowers of V. cucullata and V. sagittata, many other species were brought under notice, and important differences remarked in leaf, flower, and stem, which do not seem to have been previously reported. V. cucullata and V. sagittata are connected by every conceivable intermediate form of leaf variation and superficial characteristics, and V. palmata also connects with the former by insensible gradations. V. cucullata and its varieties are, however, distinguishable from either of the others mentioned by the decumbent habit of the cleistogamous flowers. In V. sagittata, on the other hand, the cleistogamous flowers are invariably erect. For some time it was difficult to know whether V. palmata was allied to V. cucullata or V. sagittata, but the appearance of the intermediate forms points to the former as the type. The three species of white violets — viz., V. blanda, V. primulaefolia, and V. lanceolata — are very closely allied, intermediate forms between the latter two being impossible to place accurately with either species. All three produce runners or stolons late in the season; but in V. blanda these runners are merely roots, being almost entirely under the surface of the ground, slender, and producing few or no leaves, and no cleistogamous flowers. The flowers grow from, or close to, the main rootstock, and are more or less decumbent. V. primulaefolia has the longest runners, some as much as twelve inches in length. They are comparatively stout, run along the surface of the ground, and are mostly leaf and flower bearing throughout. V. lanceolata will probably have to be referred to the same species as the latter. An important point to be noted is, that V. primulaefolia and V. lanceolata almost invariably grow in company with each other, while V. blanda generally occurs alone, and in different locations from the other two. These violets have three methods of propagation, — by petalous flowers in early spring, by apetalous flowers in the autumn, and by runners rooting at the nodes or joints. V. odorata produces both leafy runners and cleistogamous flowers; but the flowers are clustered around the main stem, instead of being on the runners. They are depressed upon short peduncles, and are sometimes almost subterranean. In V. canina, var. sylvestris, the cleistogamus flowers have peduncles not more than two inches long, generally less, while the others are from three to four inches in length. Also, while in the spring flowers only one starts from each axil, in the autumn forms there are usually two or more. V. pedata apparently never produces cleistogamous flowers, but very frequently blossoms a second time in the autumn. Specimens were collected as late as Nov. 5 in full bloom. —— A committee was appointed to prepare resolutions urging the necessity of legislative action in regard to the preservation of the Adirondack forests.

Colorado scientific society, Denver.

April 7. — The committee on artesian wells in the neighborhood of Denver made a preliminary report, outlining the basin within which the known flows might be obtained, and giving calculations as to the amount of water available. —— Mr. E. LeNeve Foster described a possibly new mineral from Mexico, having approximately the formula, $4\ Ag_2S\ .\ 6\ Pb\ S.\ 5\ Bi_2S_3$. It occurs as a massive cement to a granu-

lar mass of quartz, and may be a cosalite with about half its Pb replaced by Ag_2. —— Mr. A. H. Low described a new modification of the battery method for the estimation of copper, by which great accuracy in results is attained in from one to two hours. Substances which usually interfere with this process are either quickly removed, or their presence is rendered harmless by original methods. A full description of the process will soon appear.

Numismatic and antiquarian society, Philadelphia.

April 3. — Dr. Brinton spoke of some recent explorations made by him in the Trenton gravels, in search of the evidences of the existence of the palaeocystic man. —— Mr. Scott mentioned the fact that arrow-heads had been found at Otaheite, apparently of human manufacture, but which, upon investigation, turned out to be made by the action of the sands of the seashore under the influence of the winds. —— Mr. Barber exhibited a copper currency used by the Haidah Indians. It was a thin plate of worked copper in the shape of an axe-head, with a hole at each end, and some remarkable groovings. Its value was estimated at two dollars. They range in size from one inch to two feet.

NOTES AND NEWS.

THE following is a complete list of the papers read at the meeting of the National academy of sciences, April 15-18: — G. K. Gilbert, The sufficiency of terrestrial rotation to deflect river-courses: T. Sterry Hunt, The origin of crystalline rocks: Simon Newcomb, On the photographs of the transit of Venus taken at the Lick observatory: A. E. Verrill, Zoölogical results of the deep-sea dredging expedition of the U. S. fish-commission steamer Albatross: Ira Remsen, The quantitative estimation of carbon in ordinary phosphorus; Reduction of halogen derivatives of carbon compounds: Elias Loomis, Reduction of barometric observations to sea-level: C. S. Peirce, The study of comparative biography: C. S. Peirce and (by invitation) J. Jastrow, Whether there is a minimum perceptible difference of sensation: S. P. Langley, The character of the heat radiated from the soil: J. E. Hilgard, On the depth of the western part of the Atlantic Ocean and Gulf of Mexico, with an exhibition of a relief model; On the relative levels of the western part of the Atlantic Ocean and Gulf of Mexico with respect to the Gulf Stream; Account of some recent pendulum experiments in different parts of the world, made in connection with the U. S. coast and geodetic survey: E. D. Cope, On the structure and affinities of Didymodus, a still living genus of sharks of the carboniferous period; On the North-American species of mastodon: Theo. Gill and (by invitation) John A. Ryder, The characteristics of the lyomerous fishes; On the classification of the apodal fishes: Theo. Gill, On the ichthyological peculiarities of the bassalian realm: George F. Barker, On the Fritts selenium cell; On a lantern voltmeter: George J. Brush, On the occurrence of mercury in native silver from Lake Superior: H. A. Rowland, Progress in making a new photograph of the spectrum: B. Silliman, On the existence of tin ore in the older rocks of the Blue Ridge: H. M. Paul (by invitation), The Krakatoa atmospheric waves, and the question of a connection between barometric pressure and atmospheric electricity: John S. Billings, Memorandum on composite photographs in craniology: A. W. Wright, Some experiments upon the spectra of oxygen: Elliott Coues, On the application of trinomial nomenclature to zoölogy: E. M. Gallaudet (by invitation), Some recent results of the oral and aural teaching of the deaf, under the combined system: F. W. Clarke, (by invitation), Jade implements from Alaska: Henry L. Abbot, Recent progress in electrical fuzes: J. S. Diller (by invitation), The volcanic sand which fell at Unalashka, Oct. 20, 1883, and some considerations concerning its composition. The following biographical notices of deceased members were also read: of Gen. G. K. Warren, by H. L. Abbot; of Professor Stephen Alexander, by C. A. Young; of Dr. J. Lawrence Smith, by B. Silliman; and of Dr. John L. LeConte, by S. H. Scudder.

— Tornado circular xxi., just issued by the signal-service, accompanies a second series of preliminary tornado-charts, showing the local storms of March 11, in their relation to broad cyclonic circulation of the same date. Eight tornado-tracks are mapped, — one in southern Illinois, one in central Kentucky, the rest in Mississippi and Alabama, — all occurring between two and seven in the afternoon. Their attitude with regard to the centre of low pressure is much the same as was shown for the tornadoes of Feb. 19. They are from seven hundred to a thousand miles south by east of the cyclone centre, within the area of warm southerly winds, and just east of the area of cool north-westerly winds; the two being separated by strong thermal gradients. There were five persons killed and fifty wounded by these tornadoes. The loss would have been much more severe, had not the people secreted themselves in cellars and 'dug-outs' on the approach of the storms. A more detailed study is promised at a later date.

— Dr. G. Stanley Hall, the well-known writer and lecturer on philosophical and educational subjects, has been appointed professor of psychology and pedagogics in the Johns Hopkins university. Dr. Hall was graduated at Williams college, and at a later day received the degree of doctor of philosophy from Harvard college, and afterward prosecuted his studies in Germany under Ludwig and Wundt. His lectures have been sought for in many colleges, and his cooperation in educational associations has been highly prized. He has written for the *Princeton review*, *Mind*, *The nation*, and other periodicals; and many of his papers were collected and published in a separate volume. He is now engaged in a prolonged inquiry respecting the education of young children, from which important results are anticipated. He is a man of unusual aptitude and training; and his friends believe that in the chair to which he is now appointed he will exercise a strong influence for good,

both in promoting the study of the mind, and in the training of young men to be teachers in colleges and high schools. He has also been deeply engaged in psycho-physic researches, soon to be published. Convenient rooms and suitable apparatus for this work have been provided by the university.

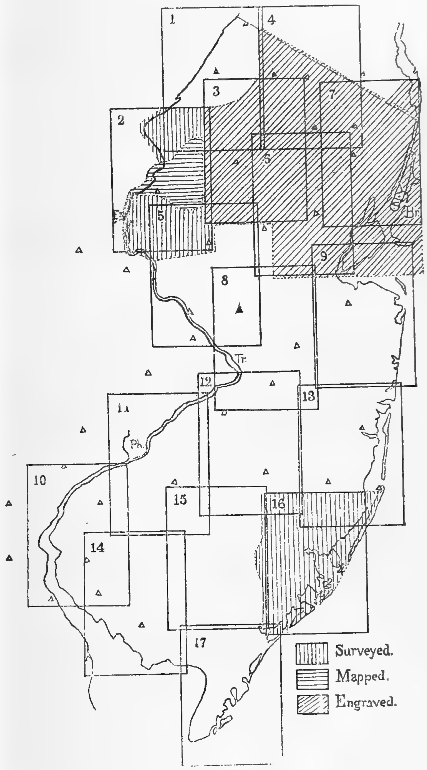
— Dr. William H. Welch, a graduate in arts of Yale college, and in medicine of the College of physicians and surgeons in New York, has been appointed professor of pathology in the medical faculty of the Johns Hopkins university. Dr. Welch is now pathologist to the Bellevue medical college in New York. He has given evidence of his ability as an independent investigator and as a skilful teacher; and, in connection with the Johns Hopkins hospital and university, he will have an excellent opportunity to advance the science to which he is devoted.

— Among recent contributions to invertebrate paleontology, we note Bulletin No. 2 of the Illinois state museum of natural history at Springfield, in which two new species of Crustacea, fifty-one of Mollusca, and three of Crinoidea from the carboniferous formation, are described by Prof. A. H. Worthen. Should the publication of a supplementary volume of the reports of the geological survey of the state be authorized by the legislature, the species now described will be fully illustrated. Meanwhile the typical specimens have been placed on exhibition in the state museum.

— A notice of some new species of primordial fossils in the collection of the American museum of natural history, New York, with remarks on species previously known, by Mr. R. P. Whitfield, appears in Bulletin No. 5 of the museum. These organisms are chiefly Brachiopoda and Crustacea, and are illustrated by two excellent plates.

— The recent geological work of the New Jersey survey has been chiefly in connection with the cretaceous formations, the artesian wells that they feed along the coast, and the crystalline rocks and their iron ores. The flowing well at Ocean Grove now yields a daily supply of sixty thousand gallons of sparkling, pure water, from a depth of about four hundred feet, or within twenty feet of the estimate, based on dip of strata, given by the survey in 1882. A second successful well has been lately bored in the same place. The drainage of the Great meadows, in Warren county, a work recommended by the survey, continues to show its efficiency: ordinary rains are quickly carried off; the autumnal and miasmatic diseases, formerly so much dreaded in its neighborhood, have disappeared; and the waste swamp-land, wherever brought into cultivation, shows a decided superiority over the surrounding high ground. Evidence is given to show the intrusive origin of the triassic trap-sheets of the Watchung (Newark) Mountains; and their crescentic outline is said to be "such as would be expected from a vertical force pressing against an inclined stratum of rock." Professor Newberry has nearly completed his monograph on the triassic fishes, and Professor Whitfield is at work on the invertebrate fossils of the New Jersey cretaceous.

— The annual report of the geological survey of New Jersey, by Professor George H. Cook, was recently published, and shows the same careful and successful administration of the survey that has been characteristic of it for several years past. In spite of the very limited cost, — "the expenses of the survey are kept strictly within the annual appropriation of $8,000," — valuable and effective work is steadily accomplished. The most considerable undertaking at present is the topographical survey of the state, in charge of Mr. C. C. Vermeule. The primary stations, shown in the accompanying figure by a small triangle,



are provided by the U. S. coast-survey, and are now nearly completed. The plan of final publication of the state map in seventeen sheets is also shown. They will be on a scale of one inch to a mile, with contours every twenty feet in the hilly districts of the north, and every ten feet in the smoother country farther south. The surveys over the roughest and most difficult part of the state are now finished; and, although half the total area is not yet covered, it is said that more than half the labor is done. The state's area is estimated to be 7,576 square miles. Of this, 1,116 square miles were surveyed last year, giving a total of 2,856. 1,893 square miles have been mapped, and 1,691 engraved. When completed, there will be prepared, also, a general map, on a scale of five inches to a mile, of the whole state. This will be printed on a sheet twenty-four by thirty-four

inches, uniform with the seventeen others; and New Jersey will then have, beyond comparison, the finest map of any state in the country.

— Reports from Mount Hamilton, California, say that this has been the most stormy winter known since observations were begun at the Lick observatory. The bad weather did not begin till so late in January that a drought in California was feared; but there have been forty inches of rain and melted snow up to April 4, and at that date the mountain was covered with two feet of snow. The anemometer cups were blown away, with the wind-gauge indicating sixty-five miles per hour. The lowest temperature was $+12°$; and at this temperature outside, water did not freeze within the uncompleted buildings.

— A communication from A. W. Howitt of Gippsland, Victoria, states that he is engaged in preparing an account of the ceremonies practised by the Australian aborigines in the initiation of their youths to the privilege of manhood. He has recently had an opportunity of witnessing some of these ceremonies, never before practised in the presence of white men.

— Mr. J. Park Harrison writes to the editor of *The academy* concerning Saxon sun-dials, as follows: "The extreme rarity of Saxon sun-dials, or, perhaps, the paucity of dials that have been recognized as such, will render the discovery of an example in Daglingworth church, near Cirencester, of some interest to antiquaries. In this case there can be no doubt that the dial is coeval with the church, which has been pronounced by several of our best authorities to be Saxon. As in other equally early examples, the five principal hours are marked on the stone, and the dial is placed over the south doorway. At Daglingworth it has been well protected by a porch of somewhat later date. I hope that this notice may lead to a careful examination of the walls of other early churches."

— Jean Baptiste Dumas, the eminent French chemist, and leader of the French academy, died April 11, at the age of eighty-four. He was born at Alais, Gard. His early scientific education was in the study of pharmacy in his native village, and, later, in Geneva. At the age of twenty-one he found his way to Paris, where he continued to be prominent till the last year of his life.

— A paper on the structure and formation of coal, read by Mr. E. Wethered before the Geological society of London, March 5, is an attempt to show, 1°, that some coals are made up of spores, while others contain few or no spores, these variations often occurring in the different layers of the same seam or bed; 2°, that the so-called bituminous coals are largely made up of a brown amorphous substance, or bitumen, to the formation of which wood-tissue certainly contributed much more than spores. In an appendix to this paper, by Professor Harker, he refers the spores found in the coals to the modern genus Isoëtes, and suggests for them the generic title Isoëtoides. In the discussion, Mr. Carruthers dissented from the view that the coal-spores are related to Isoëtes, or any other form of submerged vegetation, believing them to belong to Sigillaria and Lepidodendron. Professor Dawkins agreed with Mr. Carruthers, and also followed Professor Huxley in holding that the resinous or bituminous portion of coal is chiefly due to the spores, and cannot be derived from woody tissue by ordinary process of decay. Similar views were expressed by Mr. Newton, Prof. T. Rupert Jones, and Mr. Bauerman.

— The members of the Scientific society of Indiana university are giving special attention to the local vertebrate fauna, and to the fishes recently collected at Havana and Key West, which are in the museum of the university.

— The *Engineer* for March 21 states that Cailletet, so well known in connection with the liquefaction of gases, has constructed an apparatus for the continuous production of intense cold, which consists of a closed steel cylinder containing a coil of copper pipe which projects from each end of the cylinder. Two copper tubes are also screwed into the cylinder; and one of these communicates with the mercurial piston-pump already used by Cailletet, while the other receives the ethylene which has been compressed by the pump, and cooled by methyl chlorate. By this arrangement he forms a circuit in which the same quantity of ethylene is repeatedly evaporated in the copper coil, producing intense cold, and then compressed again by the pump being sufficiently cooled with methyl chloride, and ready for evaporation again. This process goes on as long as the sucking and compressing pumps are working.

— The report of the English secretary of legation at Rome, concerning the new national library there, is given at length in the *Journal of the Society of arts* for March 21. The Italian government has taken over from the Jesuits the celebrated Collegio romano and its observatory. Various scientific societies have their rooms on the ground-floor. The first and second floors contain the ancient library, formerly in two divisions, one accessible only to the priests. A new hall has been built capable of containing 2,400 volumes, and a reading-room capable of holding two hundred persons. With the addition of the celebrated Casanatense, the richest ancient public library in Rome, the Victor Immanuel institute has space for 1,000,000 works. It seems as if the monks had made no additions to the library for nearly a century, and the first thing to which the resources of the library had to be applied was the purchase of modern classics, Shakspeare, Goethe, etc.: the collections Didot, Hachette, and Brockhaus have been purchased. From November, 1881, to November, 1882, there were 4,594 scientific works bought, while the government officials sent in 16,186 pamphlets and other documents. The library is open from nine o'clock until three, and in winter it is open in the evening from seven o'clock until ten.

— Dr. A. B. Griffiths, who has for some time been devoting his time to the study of the origin of petroleum, and advocates the organic view, writes to the *Chemical news* that he has found phenol in the stem,

leaves, and cones of Pinus sylvestris, — a discovery which he thus connects with the results of his investigations on the flora of the carboniferous period: "Taking into consideration the fact that solid paraffine is found in petroleum and is also found in coal, and from my own work, that phenol exists in Pinus sylvestris and has been found by others in coal which is produced by the decomposition of a flora containing numerous gigantic coniferae allied to Pinus, and that petroleum contains phenol, and each (i.e., petroleum and coal) contains a number of hydrocarbons common to both, I am inclined to think that the balance of evidence is in favor of the hypothesis that petroleum has been produced in nature from a vegetable source in the interior of the globe. Of course, there can be no practical or direct evidence as to the origin of petroleum: therefore 'theories are the only lights with which we can penetrate the obscurity of the unknown, and they are to be valued just as far as they illuminate our path.' In conclusion, I think that this is a connecting-link between the old pine and fir forests of by-gone ages, and the origin of petroleum in nature."

— The new English dictionary of the Philological society, edited by Dr. Murray, and pronounced by Mr. Furnivall to be the best dictionary of any language, has only reached the word ANT, and nobody knows when the end of the alphabet will come; but part i. gives a clear indication of the plan on which the work is to proceed, and shows that scholars in all departments, and not philologists alone, are to be benefited by its publication. Indeed, the construction of this dictionary has been governed by the scientific method. The authors began by observing and collecting facts, then proceeded to classify them, and then to ascertain what was taught by the facts. Three and a half million citations were made by thirteen hundred readers. Among the collaborators were many Americans, led by Prof. F. A. March. Rev. Dr. Pierson of Iowa sent sixty thousand quotations. From such resources, added to those already at command in Richardson, and other general dictionaries, and in the special glossaries of the Bible, Shakspeare, Milton, Pope, etc., it has been possible to determine the history of almost every word. It is curious to observe how sometimes the course has been upward from the language of common life to that of abstract philosophy; at other times the word goes down in respectability like a drunkard, and becomes positively vulgar. Indeed, the differentiation of words resembles the development of living beings: from very simple germs, very complex organisms are evolved. The 'form-history' of a word is what the editor calls its morphology, and includes a discussion of the derivation, phonetic changes, corruption, obsolescence, revival, etc.

In order to whet the appetite of those readers of *Science* who may not have had an opportunity to examine this masterly introduction, we shall cull a few examples, taken almost at random, of the mode of treatment which Dr. Murray and his coadjutors have followed. Almost every page will give us interesting material. A good many mathematicians who know that 'algebra' is an Arabic term will be surprised to find, that, so far as can be ascertained, it came into English use first (as early as 1541) in the sense of re-integrating broken bones, so that an algebraist or algebrista was 'a bone-setter,' and ten years later (in 1551), in the sense of the science of 'redintegration,' or equation, the mathematical sense which alone remains current. The historical use of another Arabic word, 'alcohol,' is likewise interesting. Its first recorded appearance in English is in 1543, when it meant any fine impalpable powder produced by sublimation, as alcohol of sulphur; and hence it was applied to fluids, an essence or spirit obtained by distillation, as alcohol of wine, and so ultimately to an extensive class of compounds of the same type as spirit of wine, some of which, far from being volatile, are not even liquid. The very convenient scientific group of 'actinic' words appears to have been introduced by Sir J. Herschel, who invented an instrument, which he called an actinometer, for measuring the intensity of the sun's heating-rays, described by him in 1825. More than a score of words etymologically related to this are now in scientific use. By and by we may expect a like multiplication from 'bolometer,' which Professor Langley has set in motion. 'Agnostic' is traced to a suggestion of Huxley's at a meeting of the Metaphysical society of London in 1869, and he had in mind the altar referred to by St. Paul as erected 'to the unknown God.' The first use of the term in print may be found in the *Spectator* for Jan. 29, 1870. 'Agnosticism' followed naturally a few months later. 'Ant' and 'emmet' have a common ancestry in the West Saxon *aemete*. In one form or another, they have been known to our language since the year 1000. 'Aluminium' first came into use in the form 'alumium,' which Sir Humphry Davy employed in 1808. Four years later he spoke of 'aluminum,' not yet obtained in a perfectly free state; and very quickly the *Quarterly review* substituted 'aluminium' for its less classical predecessor, and this is the form now commonly adopted. The biography of 'academy' is of interest. Caxton used the form 'achadomye' in 1474, referring to Plato's dwelling; but it was almost a century later (1549, 1588) when it began to be used as the name of a modern seat of learning. Perhaps it came to England from Geneva, where a protestant foundation took the name of an 'academy,' to be distinguished from the ecclesiastical 'university.' Toward the end of the seventeenth century the Royal academy of sciences in Paris was talked about in London; and in 1769 an academy of fine arts, that which is now in London *the* Academy, was founded. The American use of 'academical' as applying to an undergraduate classical college, in distinction from a scientific or professional school, does not appear to have been noted.

— Alabama may now be said to have a state weather service. As now organized, there is a corps of twenty-two observers working under the patronage of the state commissioner of agriculture, no appropriation having as yet been made by the legislature. The service was organized in February, by Dr. P. H. Mell,

jun., of Auburn, and now issues a monthly bulletin. It is hoped, that, during the next session of the legislature, the service may be placed on a permanent footing.

— The Massachusetts charitable mechanic association announces its fifteenth exhibition to open in September, 1884, and to continue for not longer than ten weeks.

— Professor Angelo Heilprin began a course of fifteen lectures on geology, before the Teachers' institute of Philadelphia, in the hall of the Academy of natural sciences, Wednesday, April 23.

— The Ottawa field-naturalists' club, which for five years has been engaged in developing the natural history of that district, has issued a circular calling attention to its success in the past, aud urging its members and others to still greater exertions. The excursions the coming season are expected to be of especial interest, and through them it is hoped that many may be enticed to help in the scientific work. Observations of the migrations of birds are especially called for.

— What a blow it would be to the scientific farmer, if it should be proved that the Ohio floods are due to some extent to the large amount of drainage-pipe and ditches which have been introduced of late years! A writer in the *New-York herald* urges the farmers to turn their backs on the drain-tile dealer, and devote their energies to deep ploughing, that the rain may the better be absorbed.

— The *Missionary herald* for March prints the following account from Mr. Gulick, one of its missionaries in Japan: —

No matter how cold it is, shoes are not allowed in the clean, matted rooms of any Japanese hotel or dwelling. Slippers are permitted as a concession to the foreigner. After making your prostrations to your callers, the proper position for yourself and all your company is to sit in a circle about the brazier, while tea and cakes or candies are passed around. After the tea the inevitable pipe, each individual carrying his own, is produced. A little pinch of dry fine-cut, half the size of a pea, is pressed into the microscopic bowl: the gentleman bends forward on his knee with the long pipe-stem in his mouth, touches the pipe to a live coal, gives a suck, bloats his cheeks for a moment with the warm smoke, and then expels it in two streams from his nostrils; a second whiff, then with a sharp rap of the pipe on the side of the brazier, or of a box for the purpose, the ashes are expelled, and he is ready to repeat the dose, or, with an air of satisfaction, tucks his pipe back into his belt. Each member of the circle is likely to repeat this operation from five to fifteen times in an hour; and you, the one abstainer, have the full benefit.

This is but one of the discomforts. The polite manner of sitting — the only manner admissible in refined society — is another and very great one. Your caller is announced. He drops on his hands and knees, and touches his forehead to the mat: you do the same. Perhaps a second bow, and you ask him to be seated: modestly he subsides at a little distance to the rear. You urge him to come up to the brazier and warm his hands: he declines. You urge him again, and he crawls forward. You are seated; all are seated. Your instep and the top of your stockinged or slippered feet press the floor, while you sit back full weight upon your heels and the upturned soles of your feet, with your knees straight before you. You, or your travelling-companion, pass the tea and cake. You exchange a few words with your caller, perhaps spread the palms of your cold hands over the few red coals, and try to look serene and composed. If you are an average foreigner, and not of the loose-jointed kind, about five minutes in this position is all you can endure, and you are ready to exclaim, 'Who shall deliver me from bondage to Japanese etiquette?' Your agony betrays itself in your face, and one of your polite visitors begs you to unbend and stretch out your feet. Thankful enough, you relieve your aching ankles and knees by assuming the attitude of the Turk, or the Hawaiian, on the mats. Occasionally the hotel-keeper, or your host, knowing the weakness of the foreigner, offers you a chair. But as vain is the effort of the man in a chair to be sociable with those on the mats as for a man on horseback to identify himself with a company of foot-passengers. Half an hour of enforced endurance of the standard polite position will render the ripe foreigner as lame as a foundered horse. The once flexible knee-joint refuses duty. But then, the Japanese are the most polite people in the world, and they will pardon any attitude in one whom they know and respect.

— We learn from *Nature* that a London *Times* correspondent writes from Iceland that reports of a volcanic eruption in the interior were current last year, and were founded on peculiar appearances of the sky, and especially on the observation from some of the remote inland farms of columns of smoke or vapor rising in the far distance. Nothing definite has, however, been ascertained as to these phenomena. An unusually large number of scientific men, — geologists, botanists, and philologists, — chiefly German and Swedish, visited Iceland last summer, and investigated its structure, flora, and language; and at present Professor Sophus Tromholt, well known in scientific circles by his researches as to the aurora borealis, is pursuing these investigations there, and intends to remain all the winter, as, from the clearness of the atmosphere and the frequency and brilliancy of the aurora, Iceland is exceedingly well suited for his observations.

— Some figures relative to the effect of different forms of artificial illumination on health have recently been published in the English *Science monthly.* A tallow candle is far the most unhealthy agent, and the electric light the best. The heat produced by the incandescent lamp is only about one-thirtieth of that produced by the tallow candle, while there is no carbonic acid or water produced at all. It is said, one gas-jet in a room vitiates the air as much as six human beings in a room.

SCIENCE.

FRIDAY, MAY 2, 1884.

COMMENT AND CRITICISM.

All friends of science and learning must earnestly hope that the difficulties between the board of managers of the Winchester observatory of Yale college, and the observatory committee of the corporation, will be settled without injury to the institution. The organization of the observatory seems to be somewhat complex. The corporation of the college, in whose hands the supreme power is placed, finding itself unable to immediately organize the establishment, appointed a board of managers, among whom were included Professors Lyman, Newton, and Loomis, to advise and recommend measures, and to execute such plans as should be approved by the corporation. Under this authority, Professor Newton was made director before the funds were sufficient to justify the completion of the organization. The horological and thermometric bureaus were established before any appliances for astronomical work were completed. In the mean time, a heliometer of the first class, indeed the largest and finest ever made, has been procured, and arrangements made for its use by a skilful astronomer.

The present difficulty seems to have grown out of the peculiar position of the two bureaus above mentioned, which gave rise to a divergence of views on the subject of their relations to the rest of the establishment. These bureaus have done excellent work in testing thermometers and time-pieces, and in calling public attention to the lack of precision in observations of temperature, owing to defects in thermometers. Notwithstanding their public utility, the board of managers seem to have considered the propriety of their permanent support from a fund designed for scientific research as open to question, while the corporation committee desires to make them the main feature of the institution, and, indeed, to take them out of the control of the director. This committee also proposes to abolish the board of managers, which seems to imply dissatisfaction with their work, and to organize the observatory in a way which is so strongly disapproved by the board, that Professor Newton has resigned the directorship, and at least one other member has left the board. As the details of the plan have not been made public, it cannot be made the subject of intelligent criticism; but it is hardly possible to avoid the impression that the authorities of the college are not sufficiently alive to the necessity of having the observatory managed by some competent and responsible authority, whether an individual or a board.

The recent award of the gold medal of the Royal astronomical society to Mr. A. Ainslie Common of Ealing, Eng., reference to which is made in another column, should prove a powerful incentive to the amateur astronomer; and the remarks of the president of the society, Mr. E. J. Stone, in his presentation address, are no less important as indicating in general the way in which the amateur should go to work. A clear conception of the needs of astronomy in some special direction should precede all efforts to provide instrumental means; and the means should thus be suited to the ends sought. The speedy fossilizing of many an excellent instrumental outfit might thus be forestalled. The professional astronomer is frequently compelled to note the absolute incomparability of work done with the costliness and variety of the instrumental outfit; which means, of course, that scientific work of real worth is achieved, not so much by the telescope as by the observer who stands behind it. And it is worth the while, in this era of big telescopes, when the chief inquiry relates to the superior limit in size attainable, to glance backward at the results already

secured with telescopes approaching the inferior limit in aperture, and take note of the amount of work, of much the same sort, remaining to be done, largely, to be sure, of a character not intended to elicit profuse applause.

AMERICANS are less sensitive than formerly to foreign criticism, but a recent series of incidents would indicate that foreigners are beginning to be sensitive in respect to American criticism. Some six months ago a writer in *Science* called attention to the three principal currents of scientific work, — German, English, and French. He was critical in his comments, but his criticism was evenly distributed; and American work did not escape his eye. On the whole, Germany was most praised, and France least praised. The article was copied into *Nature*, and was translated for the *Revue scientifique*. The editor of the *Revue*, Mr. Charles Richet, came to the defence of France against the writer in *Science*. Now comes the work of Father Didon, on German education (*Les allemands*, Paris, 1884), which reprints a translation of the original article in *Science*, and Richet's rejoinder. The charge and the countercharge are thus brought into juxtaposition in a book which is likely to be widely read.

We are interested in Richet's answer. To the charge in *Science* that the French neglect foreign science, especially German, a flat denial is given; and a list of books translated from German into French within a short time past is printed. To the charge that the French are producing nothing new, reference is made to the current pages of the *Comptes rendus*. To the charge that "science has never been so depressed in France as at present," the chief attention is given. Mr. Richet points triumphantly to three names, — Pasteur, J. B. Dumas, and *de Lesseps;* and then, after asserting the distinction of these three leaders, the writer proceeds to look calmly at the situation. It is instructive to observe what he admits. In science, he says, France is like an army which has leaders, without soldiers enough. No French *savant* has around him a numerous group of students; and consequently the selection of professors for chairs of science is constantly becoming more difficult. It is not so, he admits, in Germany. Why is it thus in France? Because superior instruction is so poorly paid. Millions are needed to place the country in the right condition. Professorships and laboratories should be established; but, more than that, ideas must be changed, and larger numbers of young men must devote themselves to researches which have no obvious practical bearing, — *recherches scientifiques désintéressés.*

Much of Richet's comment on France would apply to this country. The United States, like France, stands in need of more professorships, and more laboratories, devoted to the promotion of science. We need, also, more young men willing to renounce careers which will yield pecuniary returns, and ready to labor for the promotion of knowledge, and the enlargement of the boundaries of human thought. But no one should consecrate himself to such a life, unless he has the assurance of support, or unless he is willing to face the restrictions of a poorly paid career.

THE tests of a theory are found not only in its accordance with facts known at the time of its proposal, but still more in its accordance with conditions discovered afterwards. The admirable studies of tornadoes now in progress, as described in our notes, are fertile in discoveries of the special conditions in which these destructive storms arise; and, as far as published, all of these newly found limitations of occurrence give the most direct support to the mechanical theory of tornadoes put forth by Mr. Ferrel a few years ago. The tornado district, as now determined, is one where warm air is overflowed by cold air: here is found the cause of the marked vertical differences of temperatures which the theory had accepted from less extended observations. The district is distinctly within a cyclonic, spiral circulation

of the atmosphere, and is found to have a very definite position relative to the centre of the cyclone; and this directly confirms the explanation given by Mr. Ferrel of the persistent left-handed rotation of the tornado, as well as of its regular direction of advance. There is no better example than this, of the successful deductive study of meteorology.

There are, of course, other theories of tornado action still held. The electrical, or, as it may be called, the vague theory is one of the most popular; but fortunately it is condemned by electricians. The theory of descending winds, or of commotions beginning in the upper air, and then descending to the ground with actual downward currents, has had not a few supporters, but now seems to be defended only by Mr. Faye of the French bureau of longitudes. The last *Annuaire* of this bureau contains a brief repetition of his *Défense de la loi des tempêtes* of 1875, in which he persists in regarding tornadoes and storms in general as down-cast draughts of air, and, strangely enough, finds proof of his statements in the descriptions of western tornadoes published by the signal-service, which make mention of the 'descent of the tornado cloud.' It is quite time that the downward 'growth' of the cloud should no longer be misapprehended, and that the real meaning of this significant appearance, so long ago well explained, should be generally understood. But, before an error finally disappears, it is natural enough to find it restricted, like an organic species on the verge of extinction, to a small habitat, like the Island of Mauritius, or the Bureau of longitudes, where it makes a determined resistance. There it survives for a time as a curiosity, a relic of by-gone days.

LETTERS TO THE EDITOR.

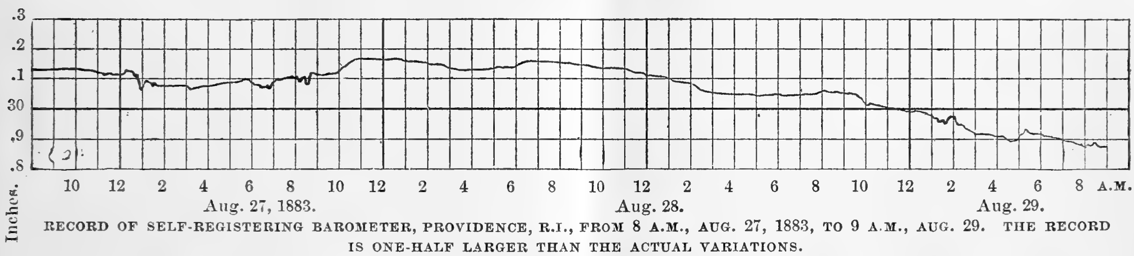
**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Atmospheric waves from Krakatoa.

I NOTICE, in your publication of the 14th of March, an account of an atmospheric wave which took place soon after the eruption of Mount Krakatoa. Thinking that it may be of interest, I enclose a copy of a sheet taken from a self-registering barometer that is under my charge. The fluctuations shown by the barometric line upon this sheet are very unusual; but, as I was in Europe at the time they occurred, I can only say that the sheet must explain itself, and that the barometer is a very sensitive and reliable one.

EDMUND B. WESTON.

Providence, R.I., April 16.



RECORD OF SELF-REGISTERING BAROMETER, PROVIDENCE, R.I., FROM 8 A.M., AUG. 27, 1883, TO 9 A.M., AUG. 29. THE RECORD IS ONE-HALF LARGER THAN THE ACTUAL VARIATIONS.

Your correspondent, '$\mathfrak{S}$.,' in *Science*, No. 63, would seem to be wrong in attributing to the atmospheric waves following the Krakatoa explosion any thing like the character of the rapid waves of compression and expansion which cause sound; for this would be the kind of disturbance referred to as following the explosions of powder-mines, which disturbance generally takes the form of shattering glass windows, and is probably due to the suddenness and unusual amplitude of the first wave of compression, or perhaps to the shivering vibrations set up in the window-sashes, or in the whole sides of wooden buildings. None of these waves could, on account of their frequency, show themselves at all on barometric traces.

In the Krakatoa waves the barograph traces, combined with the velocity of transmission, show that these waves must have been long, smooth swells (varying from fifty to five hundred or six hundred miles in length, with the shorter waves sometimes superposed upon the long ones) something like the ground-swell of the ocean, only with the waves much longer than the latter, and travelling in an elastic medium whose density and pressure vary from that at the earth's surface up to zero.

For the cause of such an unusual condition of the atmosphere, we must examine the results of the new hydrographic survey of the vicinity of Krakatoa, as published in *Nature*, 1884, Jan. 17, p. 268 (also, in part, in *Science*, No. 54, p. 211), and also the data

from the logs of some of the vessels caught in the Straits of Sunda at the time (see *Nature*, 1884, Jan. 10, p. 240).

A careful consideration of the data there available would seem to render it almost certain, that, in this Krakatoa explosion, something like two or three cubic miles, perhaps more, of earth which formed the northern part of the volcanic island and its underlying strata, were blown into the air to some unknown height, and clearing entirely Lang Island, lying immediately north-east, came down again six or eight miles to the northward and eastward. As this probably took place at a single explosion, and as large amounts of gases under enormous pressure were almost certainly suddenly set free, to say nothing of the sudden generation of steam, it is, perhaps, not to be wondered at, that this immediate demand for 'more room' should have started a series of waves in the atmosphere (like those in a mill-pond from the plunge of a stone) which travelled several times round the globe.

The vessels' logs above referred to — one reporting the barometer fluctuating between twenty-eight and thirty inches and violently agitated, and another the same rising and falling from half an inch to an inch in half an hour — show how violent was the local disturbance, which, by the time it reached this country, amounted to only about two millimetres.

Doubtless some slight effect of this kind must follow every large explosion, like that of a powder-mill, over some limited area; and it is worthy of note, that Mr. Scott, the secretary of the London meteorological council, in his paper communicated to the Royal society on Dec. 4, 1883, states that the traces of these Krakatoa waves "exhibit considerable similarity to that of the King's barograph at the Liverpool observatory, at the Waterloo docks pierhead, on the 15th of January, 1864, when the Lottie Sleigh, loaded with about twelve tons of gunpowder, blew up. The ship was lying about three miles from the observatory." But this phase of such explosions is entirely distinct from their sound and their window-shattering character.

H. M. Paul.

Washington, April 21.

Osteology of the large-mouthed black bass (Micropterus salmoides).

Very recently my studies have required me to make several dissections of the large-mouthed black bass, and carefully prepare two or three skeletons of this fish. These skeletons are now before me, and in two of them I notice a very interesting anatomical point. During the course of my reading upon the skeletons of fishes, I have failed to discover any account of a similar condition in any of the Teleostei, and note it here, trusting that I may learn from others, interested in the anatomy of this class of vertebrates, whether or no they have ever observed the same. This consists in a pair of freely articulated ribs at the base of the occiput. Their heads are received in a shallow facet on either side, situated just above and rather internal to the foramen for the vagus nerve. Immediately below each rib occurs the projection of bone that bears upon its entire posterior aspect one of the pair of articular condyles for the first free vertebra of the spinal column. Still beneath these condyles is seen the conically concave facet for articulation, with a similarly formed surface occurring on the centrum of the vertebra just mentioned, and the one which I believe would be described as the atlas.

This pair of ribs is directly in sequence with the abdominal ribs on either side. Their occurrence in this situation might be accounted for by saying that several of the anterior vertebrae of the column had been absorbed by the occipital elements. Mr. Bridge found such a condition in Amia, though no free ribs were present (*Journ. anat. phys.*, xi. 611, Lond., 1877). In the cranium of Micropterus, however, I should think that this would be highly improbable. Both the first and second vertebra of the spinal column of this bass support each a pair of free ribs, and a mid-series of the other abdominal ribs bears epipleural appendages. Dr. Günther states in his account of the osteology of the Teleostei, in article 'Ichthyology,' of the Encyclopaedia Britannica (vol. xii., 9th ed.), that "the centrum of the first vertebra or atlas is very short, with the apophyses scarcely indicated. Neither the first nor the second vertebra has ribs." I have a yellow perch (Perca americana) in my possession where both of these vertebrae support a pair of free ribs.

Should an examination of the young of the black bass show that none of the anterior vertebrae of the column were included with the occipital segments, but that these ribs are truly occipital ribs, then they become of interest from several points of view.

R. W. Shufeldt.

Washington, March 31.

Caulinites and Zamiostrobus.

As *Science* has devoted a page of its valuable space to Mr. Joseph F. James's copies of Mr. Lesquereux's figures of these plants and his remarks thereon, in which, without having seen the specimens, he essays to overthrow the determinations of the venerable paleontologist, a word in reply may be justified as tending to correct the impression, already quite prevalent, that the determinations of vegetable paleontologists are in large measure mere guess-work.

As regards Caulinites fecundus, little need be said, since its problematical character was sufficiently insisted upon by Mr. Lesquereux in his description. The 'capsules' are much smaller than those of Onoclea sensibilis, and are found in intimate relation with the stems which have been called Caulinites. The matrix is a light, fine-grained shale, showing the longitudinal, parallel nervation of these stems very clearly. It also contains fragments of dicotyledonous leaves which may have belonged to the plant that bore the fruit; but no ferns are present, as these would be clearly shown by their characteristic nervation. It is safe to say, that, if Mr. James had examined the fossils, he would not have said that there was "no doubt" in his "mind that Caulinites fecundus is nothing but a part of the fertile frond of Onoclea sensibilis."

As regards Zamiostrobus, however, there is 'no doubt' that Mr. James is egregiously in error. His confident statements well illustrate the folly of discussing mere figures of objects that are in existence. He has entirely misapprehended the nature of the specimen; and this is not altogether the fault of Mr. Lesquereux's figure. The fossil is a segment of a zone, cut out of a cylindrical or conical body which must have measured about eight inches in diameter. This segment was placed with the exterior surface upward in the drawing, in order to show somewhat in perspective both this surface and the radiate structure of the cross-section from the direction of the centre. The figure is defective in not showing the manifest angle which all the dark spots have on one side, and which fixes their true character as scars of former leaves. It is probably not a cone, as Mr. Lesquereux supposed, but a fragment of one of those

dwarfed cycadean stems or trunks which formerly went by the name of Cycadoidea, but which the Marquis Saporta (Paléontologie française, Végétaux, II.) now divides up into the two new genera, Bolbopodium and Clathropodium. From an examination of his figures, I am inclined to refer it to the latter of these genera. Although found at Golden, Col., which is cretaceous or Laramie, still it is not impossible that this specimen may have been in some way brought to this spot from a locality higher up the adjacent slope, having a position stratigraphically lower. LESTER F. WARD.

The Greely search.

Safely assuming that *Science* admits within its domain facts only, and willingly dismisses errors of observation, I respectfully offer the following corrections of some inadvertences found in your notice, March 28, of the action of the Navy department, and its board of relief for Lieut. Greely.

It is an error to suppose that the report was founded, 'in great part, on the counsels of Capt. Nares and his associates;' for the joint letter of Nares, Markham, and Fielden, dated, as the report shows, London, Feb. 1, could not have been in the board's hands until nearly a month after their submitting that paper, the publication of which was delayed for these and other valued counsels.

The necessity of leaving the ice-navigation 'absolutely' to the judgment of the ice-navigators, that is, to ice-pilots, is also in this case a fallacy. Neither the whalers nor the sealers go north of 70° north latitude, and can have no knowledge of the ice movements in Kane basin, for action in which, the commanding officers are likely to gain as much knowledge as ice-navigators, so far as this *can* be gained in lower latitudes. Once in the basin, the whole problem depends on the judgment and skill of the officer, who must, by careful observation of the local tides and weather, determine when and where to advance. The writer of your notice has ignored the plain fact that the commander, as the only responsible person, must also be the absolute judge of the ship's movements among the most fickle of all known conditions, — the ice-changes. He must, almost without ceasing, be on the watch and in the crow's-nest. In that 'sort of tub,' Hartstene, when out in the search for Kane, "stayed for thirty-six hours on the stretch, with but a bowl of soup sent up to keep body and soul together;" and, according to Markham, Nares almost lived there, from the nest closely scrutinizing the ice motions, the tides, the currents, and the influence of the wind on the pack. "It was entirely due to this that the expedition advanced, although inch by inch." That an ice-navigator of the ordinary type should be equal to this watchfulness, is scarcely among the possibilities; and in this connection the experience of the Proteus is most unfortunately cited by your correspondent, if the captain of that vessel was correctly reported as being confessedly very rarely in the nest. Nor, in another point, is the case a parallel one, inasmuch as the needed naval qualifications could not be expected to be found in an army officer, however marked were his courage and admitted sagacity.

The statements in regard to the failure in providing for scientific observations, and as to the programme of the cruise, are equally at fault. The final decision of the programme for the expedition could not have been made at the date of the writing, and, indeed, has not yet been made known. From the nature of the case, much must be left to the discretion of the officer commanding: he must, as in the case of previous expeditions, sail 'untrammelled.' So far as opportunity shall offer for scientific observations, these will be made by the use of two complete scientific outfits, including photographic apparatus, carefully prepared for meteorological and magnetic work, if the ships should winter north. For this, as well as for previous expeditions, special instructions have been laid down by the department for such observations as will not interfere with the main object. The ships will take out three young officers of the number, which, under the sanction of Secretary Chandler, have been recently on duty at the Smithsonian, under training for just such work. They will be thus prepared to carry out the instructions of Professor Baird, so far as the ever-changing circumstances of the cruise shall permit.

May not the very grave responsibilities of this errand of mercy be intrusted to the department and its selected officers, conscious, as they assuredly are, of these responsibilities, and hoping for that success for which the hearts of the nation wait, as attested by the unlimited appropriation placed at the discretion of the president? When De Haven went out in the search for Sir John Franklin, Admiral Osborn openly said, "I was charmed to hear that officers and men signed a bond not to claim any part of the reward of £20,000 offered by the English government."

Unaware of the existence of any lower tone of character in those who now leave their homes on an errand of humanity, yet of grave uncertainty of success and of personal danger, I submit the preceding corrections, which might, indeed, be extended. They will commend themselves as due to the Navy department, to the officers, and to the mixed board from the army and navy, whose report itself evinces much previous arctic study, and close attention to the wants of the expedition. J. E. NOURSE.

[The question as to whether an officer entirely without experience, and therefore necessarily without skill in meeting certain exceptional conditions, is as well qualified to do so as one who has gained skill by long experience, is one, which, divested of sentiment and class feeling can have but one answer. We are not aware that floating ice north of latitude 70° possesses any occult qualities which it loses on drifting south of that imaginary boundary. The skill and watchfulness of the ice-navigators of the sealing and whaling fleet is a fact which does not depend upon any one's opinion, but has been proved by long years of successful adventure. That the owners of this fleet should require some guaranty in case of success, for putting their property in jeopardy, for what many regard as a forlorn hope, is merely reasonable; and no just parallel can be drawn between them and officers of the navy, who have no pecuniary stake in the vessels to which they are temporarily assigned. The statement in regard to scientific work, 'not inevitable to the expedition' (like meteorological observations), was made on the best authority; and we shall be pleased to learn that the first intention of the commander of the expedition has been modified in the manner the writer intimates. That the counsels of Sir George Nares and others had great weight in determining the report of the board, we judged from internal evidence, from the fact that the report was delayed until those counsels were made known, and because it would have been most reprehensible if they had not received respectful attention.]

STYLE IN SCIENTIFIC WRITING.

THE conductors of this journal have had for more than a year an opportunity to judge of the literary aptitudes of the scientific writers of this country. The pecuniary resources of *Science* have been sufficient to enable the editor to pay suitably for accepted contributions: his correspondents have been sought in all the places of intellectual activity in this country. Young writers and old, men of fame and the obscure, have all been welcomed as helpers, provided they had any thing worth saying. It is not for us to pronounce upon the results which have been attained, but it may be worth while for us to point out how our friends and helpers can make this journal still more acceptable to those who read it.

We begin with a general principle. One of the results of scientific study is to make men accurate, to encourage exactness in thought and expression. The first quality, therefore, to be desired in scientific writing, is trustworthiness; and, without it, all other merits are of no account. On this point we have no suggestions to make; for our writers, as a class, are men whose statements of fact may be taken with the greatest confidence.

But in addition to accuracy, scientific writing should be in good form. Indeed, proper attention to literary requirements will promote rather than embarrass the desired precision. One of the clearest and most acceptable writers on scientific subjects told us, in reply to the inquiry how it was that he made himself so easily understood on difficult points, that it was because, before addressing a mixed assembly on any abstruse or complex theme, he took great pains to find in advance just the words and the phrases which conveyed his meaning. Certainly one reason why the writings of Darwin, Spencer, Huxley, Tyndall, and Lubbock, — to specify only foreign writers, — have been so widely read, is that their language is so good. It is easy to understand their meaning, for they comply with the well-known law of a well-known authority on style; the desideratum, he tells us, is "so to present ideas that they may be apprehended with the least possible mental effort." We are inclined to add to this dictum of Herbert Spencer the declaration that a good style will exact that amount of attention which animates without fatiguing the reader. Verbosity, awkwardness, undue conciseness, forgetfulness of the reader's attitude, are errors into which it is easy to fall: clearness, fitness, grace, are merits which it is hard to acquire. That which stimulates further thought, and invites to continued reading, is the kind of article most to be desired.

Those writers will do best who keep constantly in mind the audience they are called upon to address. *Science* is not a journal for any class of specialists. It is not published for the sole benefit of the entomologist, or the electrician, or the geometer, or the morphologist, but for the perusal of all such persons, and also of teachers, librarians, engineers, physicians, editors, lawyers, clergymen, and other intelligent and educated men and women who wish to keep informed upon the progress of scientific discovery in all its general aspects, and who wish to be directed to more detailed statements if they have occasion to seek for special information. These pages should present articles so trustworthy, and at the same time so readable, and from writers of such acknowledged ability, that every educated person will be obliged to keep his eye upon all that we print, particularly if he is engaged in any pursuit connected with science.

This is the aim of the conductors of this journal. But such a purpose can never be fulfilled without the hearty co-operation of all the leading scientific men of the country. No editorial staff, however large and complete, can possibly prepare the requisite articles. All that we can do is to call forth, arrange, adjust, amend, and edit that which is produced in the various laboratories, studies, museums, colleges, and technical schools of the country.

Our contributors must, however, remember that the editorial judgment calls for articles by leaders in one department which will be satisfactory to men of intelligence in other departments. As a general rule, the chemist must write so that the biologist may understand him; the mathematician must keep his language of symbols for his own pages, and present us only the conclusions which are of general interest.

But there are limitations to this general principle. There are some announcements so important, or so new, that we shall gladly open our columns to them, in whatever form they are made. Contributions which bring out for the first time important discoveries and researches will always be welcomed, even though they are technical. Words are constantly migrating from the domain of the specialist into that of the general reader. The progress of information rapidly tends to familiarize the public with the scientific vocabulary. It is not against the use of fit words that this article is directed, but against the abstruse, complex, scholastic diction, which any writer may turn, if he will, into clear and accurate English.

ICEBERGS AND ICE-FLOES.

In the Atlantic, the great oceanic base for by far the larger number of arctic expeditions, icebergs sometimes reach as low as the latitude of Boston. They are to be dreaded mostly in the night, and sometimes in very heavy or foggy weather. This danger, therefore, steadily decreases as the ship nears the pole; and, when she passes the arctic circle far enough to encounter perpetual daylight, it ceases. It is in the lower latitudes, and especially during dark, foggy nights, so common to those regions, that the sharpest lookout must be kept; and here, also, the berg, meeting warmer waters and climate, is, in its disintegration, widely surrounded by a vast *débris* of smaller masses, most of which are equally as dangerous as the parent.

There is one peculiarity of icebergs that is fortunate for those cruising in their vicinity; and that is, their visibility at long distances during dark nights and heavy weather. I remember on the 10th of July, 1878, while making for the eastern entrance of Hudson's Strait, and while off the Labrador coast, our second mate, a keen-eyed Scotchman, caught the faintest glimmer ahead, during a misty morning, about two o'clock, when daylight was just commencing to break. He pronounced it an iceberg, and estimated it to be two or three miles away; and, wearing ship and laying to, we found in the morning that he was not any too far out of the way. This colossus of ice was flanked on either side by its *débris* for three or four miles, some of the pieces standing fully as high as the foremast of our little schooner. With my unseamanlike eyes, even with the aid of a powerful marine glass, I could only make out the slightest break in the inky clouds hugging the horizon; and the mate told me that the navies of the world, a score abreast, could have passed between us and the berg and been invisible. It is a peculiar sheen of their half-polished faces, characteristic of glacier ice, that penetrates so far, and under circumstances where a bank of snow or a ship's sails would not be seen.

So much has been said for and against the thermometric detection of the presence of ice and icebergs, that I dislike to open the subject. Generally, if a ship is approaching ice or icebergs, repeated observations made by plunging a thermometer into the water alongside, or a bucketful from the sea, soon shows the fact by decreasing temperature. These observations are more valuable in the summer than in the winter months, and also the farther south the ice may be encountered, owing to the more rapid change in the observed temperatures under these circumstances; but as nearly all arctic navigation is performed in the brief summer of these regions, and as it is only in the lower latitudes that the nights at this time are sufficiently long to cause apprehension, these observations here become of more value than in true arctic navigation. In the winter season, if the temperature of the water falls as low as 34° F. from a previous higher standard, it may reasonably be inferred that ice is not much farther away than half a mile: 42° F. shows about the same distance in the summer, the thermometer falling rapidly as the vessel approaches. However, the thermometer shows a higher temperature in deep than in the shallow water on banks, shoals, and near the coast-line, often falling from 2° to 6° F. as the latter are approached. But a good chart and a fair degree of accuracy in dead reckoning will avoid confounding this with the decrease due to approaching ice. In the case of an iceberg stranded in a current, it is evident that even this valuable sign will fail on the current-washed side; so that when a vessel is running with an ocean-current where a berg is liable to ground, or where, from its great depth, the berg is subject to some more powerful under-current than exists on the surface, the only safeguard is in a vigilant lookout. A sailing-vessel, especially if she be small, should never approach an iceberg too closely, if there is any danger of becoming becalmed, especially in warm waters; as their disintegration, if of a colossal nature, is sufficient to throw quite a large ship on her beam ends, if taken at a disadvantage. Sir John Franklin had the ship's pinnace of the Trent thrown ninety-eight feet by the disruption of an iceberg about half a mile distant, which so completely stove the craft, that they were forced to a very annoying delay to repair it before they could return to the ship. This rupture had been determined by the firing of a musket by one of the party.

Even if there be a good wind, there is some danger in running under the lee of a large berg, the eddying of the wind forcing a ship on the ice, while if too near by, sailer or steamer, it is not impossible that their keel might meet one of the newly 'calved' icebergs that occasionly come boiling up from a great depth; in which case shipwreck would be almost inevitable to a ship taken at such a disadvantage.

Before discussing arctic navigation, as confined to the arctic region, something should be said regarding the variation of season. Nothing is more favorable to ice-navigation than a propi-

tious season; and the history of the polar zones is replete with instances where explorers at different times have found the most startling variations in the state of the ice in the same locality, and at the corresponding time of the year. So well is this fact appreciated by experienced navigators of these waters, that you

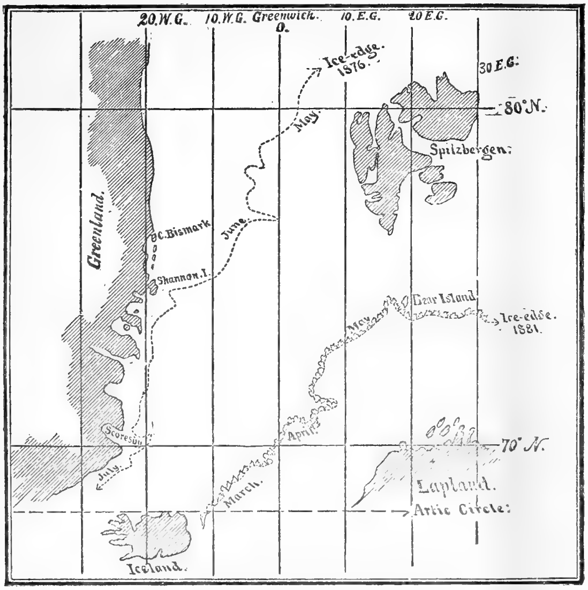


FIG. 1.—ICE-FIELDS IN 1876 AND 1881.

will seldom find one eager to give that credit to arctic nautical success so often fully accorded by the press and the public. Rightly estimating that it was not altogether superior management over his more unfortunate brethren, but largely due to the fortunate circumstance of a lucky season, which is a problem defying calculation, Lieut. Payer has pointedly said, "The commander of an expedition must possess sufficient self-control to return as soon as he becomes convinced of the existence of conditions unfavorable for navigation. It is better to repeat the same attempt on a second or even a third summer than with conscious impotence to fight against the supremacy of the ice." Splendid as this maxim appears upon the face of it, it nevertheless has the weak point, that it is based on things as they should be, rather than on things as they are; and should any arctic commander, actuated by honorable motives, adopt such a course, he would probably find this maxim, when he returns home, exchanged for, 'Nothing succeeds like success;' and, should the same attempt be repeated on a second or third year, it is more than doubtful if he would find himself retaining his original position. Nothing can show the variable state of the ice at different seasons so well as the accompanying map (fig. 1) of the ice-edge between Greenland and Spitzbergen, upon the authority of the Bremen geographical society's publications for 1876 and 1881. The explorer of 1876 would have been counted as a great success, and his equal brother of 1881, a failure.

The next difficulty encountered by a vessel will be the outlying ice-packs; and much has been said on this, while considering the relative merits of steam and sails (p. 506). The commander has now before him two general routes, one of which is to keep well out to sea, if the breadth of the channel will permit; and the other is to hug the shore-line. This point seems to be pretty well settled at this hour, and in favor of inshore navigation when in the vicinity of ice. Confirmed to a greater or less extent by Barentz, Hudson, Baffin, the two Rosses, and others, including the whalers constantly visiting these climes, it was reserved for Sir Edward Parry to bring the matter in such prominent light before the public as to provoke the most bitter discussion, and revive all previous experience on the subject, with the above result. Returning from his first voyage, he says, "Our experience, I think, has clearly shown, that the navigation of the polar seas can never be performed with any degree of certainty, without a continuity of land. It was only by watching the occasional openings between the ice and the shore, that our late progress to the westward was effected; and, had the land continued in the desired direction, there can be no question that we should have continued to advance, however slowly, toward the completion of our enterprise." In his second voyage he reiterates substantially the same opinion. So necessary was the continuity of land considered by the British admiralty, after Parry's deduction, that several expeditions were by them fitted out to explore the arctic coast-line of the American continent, in order to more intelligently direct a vessel through the north-west passage in conformity with this idea. One of the greatest advantages of coast-water navigation over that more remote, even when the latter is possible, is the assurance of a winter harbor, should the young ice form so rapidly as to prevent farther navigation,—a not unusual circumstance in these regions, where the change of season is short and decisive.

Another advantage is in the fact, that if the body of water in which the vessel is cruising be of considerable extent, and ploughed by ocean-currents, the ice well out to sea does not become fixed nor solidly frozen during even the severest winters; and a vessel thus embayed is at the mercy of the grinding ice-packs caused by the winds and currents at a time when, even if she were liberated, the intense cold of that season would make it rigidly impossible to manipulate her; and, in fact, a liberation under these circumstances would be the very last thing to be desired. The Tegetthoff and Jeannette, in their drifts, were thus partially fortunate, although suffering from constant dread of liberation; and Franklin's ships had the advantage that Victoria Channel, through which, it seems, they attempted to take the middle course, is sufficiently narrow to freeze from shore to shore, and prevent the miseries of a winter's drift. Sir George Back, in the Terror, drifting through Fox Channel and Hudson's Strait in the winter of 1836–37, did not fare so well; and his terrible sufferings, unable to house his vessel in snow-banks, which were constantly torn from his ship's sides by the ceaseless disruption of the ice-fields as fast as made, and many times forced, during heavy gales, to hastily abandon his ship, with a scanty supply of clothing and food, in the arctic winter night, expecting the crushing of his vessel in the whirling, upheaving ice-floes, show plainly the great extent of misery and sufferings which a crew may be called upon to bear when not safely harbored for the winter.

Another consideration on inshore navigation I will give in the words of its author, Lieut. Payer, who says, —

"A strip of open water, which retreats before the growth of the land-ice only in winter, forms itself along coasts, and especially under the lee of those exposed to marine currents running parallel to them; and this coast-water does not arise from the thawing of the ice through the great heat of the land, but from the land's being an immovable barrier against the wind, and therefore against ice-currents. The inconstancy of the wind, however, may baffle all the calculations of navigation; for coast-water, open as far as the eye can reach, may be filled with ice in a short time by a change of wind. Land-ice often remains on the coast, even during summer; and in this case there is nothing to be done but to find the open navigable water between the extreme edge of the fast-ice and the drift-ice. Should the drift become pack-ice, the moment must be awaited when winds setting in from the land carry off the masses of ice blocking the navigation, and open a passage free from ice, or at least only partially covered with drift-ice."

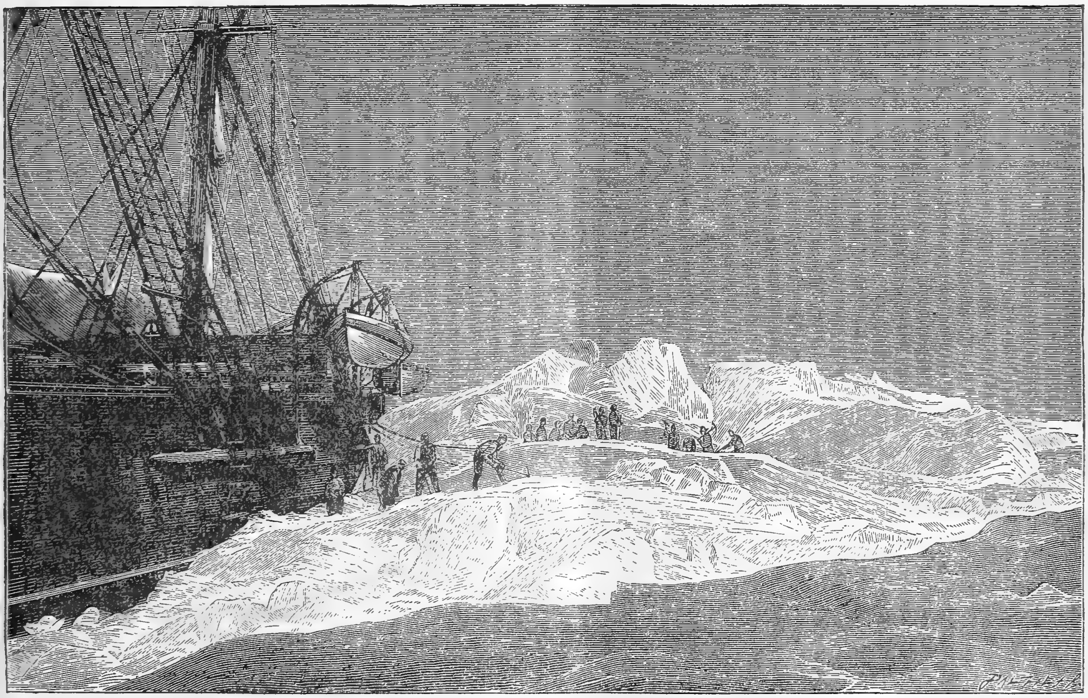


Fig. 2. — Reducing a floe-berg.

From all the above, it is evident that navigation in coast-waters must be slow and gradual, although it has always been attended with the greatest advantages. Inshore navigation is not without its hinderances, however, and especially is this the case where the water near the coast is very shallow; and this could be remedied only by a light-draught vessel, which has the disadvantage that such a vessel cannot conform to the build already indicated. This is especially the case on the polar shores of the mainland of America, Asia, and most of Europe, while in the channels and waters north of them the land rises higher, the navigable waters approach more closely to the shore, and progress forward becomes more easily assured. Also in coast-water cruising, a vessel forced upon the shore by the incoming pack, backed by a heavy gale, is in a more precarious state than one simply grounded or lifted upon an ice-field.

A ship once fairly beset, and strongly held during a gale, is completely beyond control; and no real good can be accomplished by the severe tasks of warping and continual shifting of ice-anchors, which only exhaust the crew, and render them more or less unable to take a thorough advantage of a favorable situation, should one occur. Parry, however, under these circumstances, did not hesitate to employ his crews to their utmost at the hawsers and sails, plainly acknowledging that "the exertions made by heaving at hawsers, or otherwise, are of little more service than in the occupation they furnished to the men's minds under such circumstances of difficulty; for, when the ice is fairly acting against the ship, ten times the strength and ingenuity could in reality avail nothing." But the greater majority of ice-navigators are now decidedly of the opinion that it is best to yield to fate, and reserve the men's strength for palpable efforts. Still, in these besetments the mind of the commander must be ever active; for new events follow each other so rapidly, that a favorable chance for rescue is passed, before it can be fairly weighed in all its aspects.

FREDERICK SCHWATKA.

NOTES ON HIBERNATING MAMMALS.

A VERY prevalent impression exists, that hibernation among mammals is so fixed a habit that it may be defined in a few words, that it occurs with all the regularity of sleep, and is as necessary to the creature's welfare as food or drink. So far as these hard and fast lines are drawn, so far is our understanding of the subject warped and imperfect.

In the ninth edition of the Encyclopaedia Britannica, hibernation is defined as that "peculiar state of torpor in which many animals which inhabit cold or temperate climates pass the winter." Here we have the characteristic feature of the habit clearly expressed; but, when we come to consider the minor details, we do not find that any two animals, however closely allied, hibernate in precisely the same manner, nor do individuals of the same species always hibernate alike. Further, we do not find that it is so common an occurrence as usually supposed; and no animal appears to hibernate merely because winter has 'set in,' regardless of the temperature then prevailing. My own studies of the animal life in this neighborhood (central New Jersey) lead me to conclude, rather, that it is a happy faculty, which certain animals possess, but do not willingly exercise. If the prevailing temperature forces them, in self-defence, to hibernate, they can; but so long as they are able to withstand a low temperature, and food is accessible, they resist. Other causes than cold may induce an animal to hibernate; as when deprived of the supply of food gathered during the preceding autumn. In such a case, squirrels will pass the winter in a state of torpor, however mild the weather; while, with an abundant food-supply, they will simply sleep through the colder days, and awake to feast whenever the sun shines brightly.

Of the thirty or more mammals found here, thirteen species are supposed to be hibernating animals. These are four species of bats, two of moles, three squirrels, one ground squirrel, one marmot, one jumping-mouse, and one Hesperomys. Of these, probably the bats are the most sensitive to cold, and avoid exposure to it with the greatest care; and yet I find that the little red bat (Atalapha novaeboracensis) is very late in retiring for the season, and reappears with great regularity early in February. Their actions at this time indicate that considerable food is to be had, — that flying insects are abundant. While this bat's ordinary habits do not differ noticeably from those of the other species, it is apparently less sensitive to low temperature, and needs but the least encouragement to arouse from its hibernating sleep. It is also less crepuscular in habit than the others; but I do not know that this fact has any bearing upon the irregularity of its hibernation.

Bats disappear in November or December, immediately after the formation of ice, but do

not seem affected by a mere succession of hard frosts. As insect-life is not materially affected by the first few frosts, there does not seem any reason for their withdrawal from active life, and therefore it is not surprising that even up to Christmas, bats should be seen flying, at sunset, in considerable numbers. When the steady cold of an average winter fairly reaches us, bats hibernate in two ways. If they resort to the ordinary shelter of a hollow tree, or similar locality, that is considerably exposed to the wind, then many individuals cluster together; and contact is mutually beneficial, for the torpor of hibernation is not rapidly, but rather gradually acquired. Such clusters of bats, if disturbed immediately after gathering together, are as resentful as when captured during midsummer; and not until three or four days have elapsed do they become insensible to disturbance. If this be very violent, and the creatures roused suddenly, a curious condition of aimless activity ensues, but lasts for a short time only, and often ends in death.

THE DUSKY BAT, VESPERTILIO FUSCUS (ONE-HALF NATURAL SIZE).

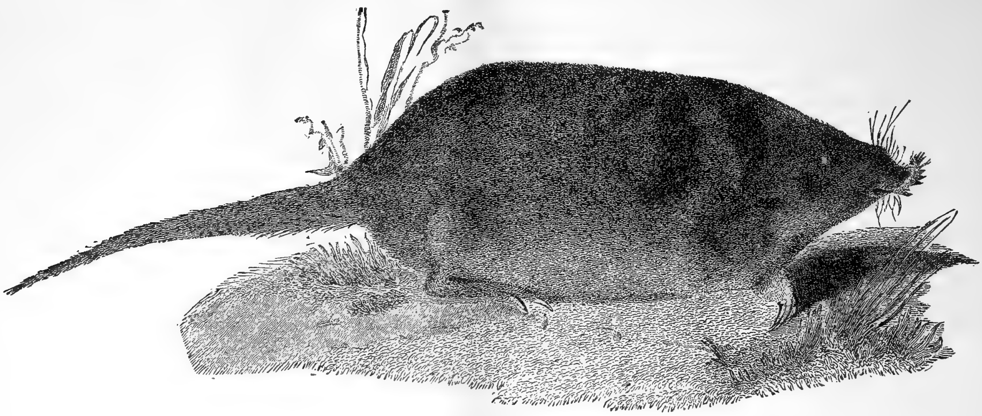
On the other hand, I have very frequently found solitary bats in curiously out of the way places, where they were so protected that they could not have suffered from the severity of the season, however intense. In such cases the torpor was never profound, the temperature of the body but little reduced, and the heart's action almost normal. For instance: a single dusky bat (Vespertilio fuscus) slept, or hibernated, as described, for thirteen weeks, in the attic of my house. It clung to a nail driven into the wall of the chimney, and was protected by a piece of woollen cloth hanging from a beam above it. The chimney retained a little of the warmth derived from the three smoke-flues which passed through it, and which were in constant use during the time. This bat could be taken down and hung up as readily as an inanimate object, yet clearly showed that it was conscious of the disturbance to which it was subjected. Once I brought it into a warm room, when it revived in thirty minutes, and flew about the apartment, but not with a very steady, well-directed flight. When taken again to the attic, it responded to the effects of the lower temperature by resuming its former position, after a steady to and fro flight from end to end of the attic for nearly an hour. The bat seemed to be wholly aware of the position of the nail in the chimney, and, when wearied of its flight, turned to it directly, and, folding its wings about it, seized the nail with a tighter grip, and hung, head down, as it had been doing. In two hours I went to it again, and found it as indifferent to handling as before.

The two species of moles so common with us hibernate in quite different ways, the habit varying as much with them as does the character of their respective habitats.

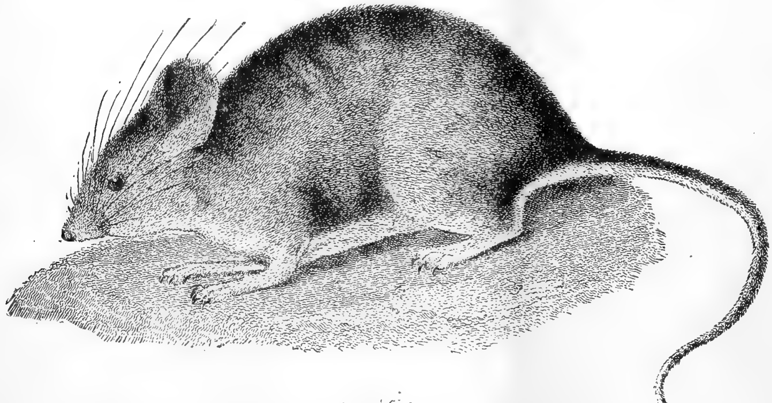
The common mole (Scalops aquaticus) — which, by the way, is in no sense aquatic — burrows deeply into dry soils, keeping just beyond the frost-line; and there it remains, without a nest of any kind, until the warmth of the spring sunshine melts the frost, loosens the soil, and sets the subterranean prisoner free. If, as sometimes happens, the cold is unusually intense and sudden, the ground freezes below the resting-places of the hibernating moles, and then they are frozen to death. This, I judge, does not often occur; but the approaching frost rouses them sufficiently to place them

on their guard, and forthwith they burrow a little deeper.

It is very different with the meadow-haunting, star-nosed mole (Condylura cristata). This mammal has more complicated burrows than those of the preceding, and often one or more openings to them are beneath the surface of the water. At some point in their tangled tunnellings, these moles form commodious nests, placing a good deal of fine grass in them. Here, indifferent to freshets, they remain all winter, and, as they can lay up no food, sleep, I suppose, through the entire season. The fact that these moles are unaffected by being submerged during the spring freshets is an interesting fact. So far as I have examined their nests, there was nothing to show that they were water-tight; and I think that the animals must have been thoroughly soaked for from forty-eight to seventy-two hours, the ordinary duration of the high water. If through any cause the period of submergence was prolonged, it is probable that it would prove fatal to the moles.



THE STAR-NOSED MOLE, CONDYLURA CRISTATA (FIVE-EIGHTHS NATURAL SIZE).



THE WHITE-FOOTED MOUSE, HESPEROMYS LEUCOPUS (NATURAL SIZE).

The short-tailed shrews (Blarina brevicauda), on the other hand, which are closely akin to the foregoing, are full of life and activity all winter. No severity of the weather chills their ardor; but this is not to be wondered at. Their favorite food is grasshoppers, and these are to be had in abundance the season through. Every warm day brings hundreds of half-grown, wingless grasshoppers to the surface, where they move about very actively. Feb. 3 of this year I found literally millions of them hopping over the dead grass, in the meadows, as restlessly as though it were August. The ground was frozen, and the sunlight had merely dried and warmed the tangled mat of dead grass upon the surface. At various points I found the openings of tunnels, which I took to be the pathways of the crepuscular shrews, — shy little creatures, that towards sunset come to the surface, and forage during the twilight.

Omitting reference to the winter habits of the familiar squirrels and woodchuck, or marmot, let us consider briefly the two small rodents found here, that are also hibernating

animals, — the jumping-mouse (Zapus hudsonius) and the white-footed mouse (Hesperomys leucopus). These two mice, popularly so called, hibernate with great regularity in one sense, but differ *inter se* in another. The former, once torpid, remain so until spring, a few warm days in winter failing to rouse them; but the white-footed mouse seems simply to sleep soundly rather than grow torpid, and responds with considerable promptness to any disturbance. The jumping-mouse builds a nest of leaves and grass at a considerable depth from the surface of the ground (not a 'ball of mud,' as stated in the Encyclopaedia Britannica, art. 'Jerboa'), and, once fairly settled therein, is beyond the various sudden changes of our winters: the white-footed mouse, on the contrary, utilizes an old bird's-nest, or has a resting-place beneath a log or in a half-decayed stump. In such positions, of course, the occupant is more likely to be disturbed, and is also directly exposed to the varying temperature.

FIG. 2.

Is it to meet the requirements of this condition that this mouse lays up a goodly stock of food during autumn? — something the jerboa, or jumping-mouse, does not do. However this may be, the fact remains that both these rodents are quite sensitive to cold, and hibernate

FIG. 1.

as soon as winter sets in; yet how very differently is this faculty exercised! C. C. ABBOTT.

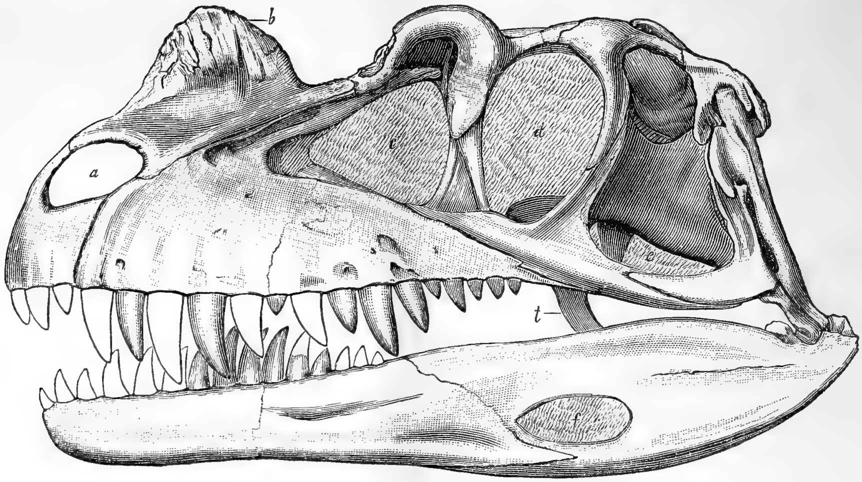
ANOTHER ANCIENT HUMAN SKELETON FROM MENTONE, FRANCE.

WE owe to the favor of Prof. Spencer F. Baird, secretary of the Smithsonian institution, photographs of a human skull exhumed last month from one of the grottos at Mentone, France (next to that in which Rivière discovered a skeleton twelve years ago), together with a letter from Hon. Thomas Wilson, U. S. consul at Nice, under date of March 31, from which we extract the following statements: —

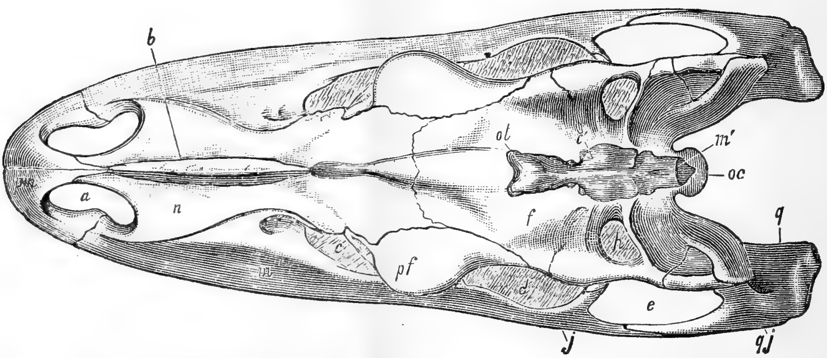
The skeleton to which the skull belongs was found in the 'fourth cavern,' at a depth of eight metres and a half, under well-defined strata; one, a metre and a half thick, composed of cinders, ashes, burnt earth, and charcoal. More or less worked flint chips were found with it, comparing well with those found with Rivière's skeleton.

The skeleton was complete; but, as the result of a quarrel over the ownership, the body was stolen, and its whereabouts are still unknown.

The skull was broken in the exhumation, but is nearly perfect; and, when found, a large flint chip was found resting against the top of the head, as shown in fig. 1, and two others resting like epaulets against the shoulders. The length of the skull, from the back of the head to the forehead, was eighteen centimetres, and from the back of the head to the projecting eyebrows, nineteen centimetres and a half: the breadth was fourteen centimetres. One femur was saved from loss, and measured forty-nine centimetres in length.



Skull of Ceratosaurus nasicornis Marsh; side view.



Skull of Ceratosaurus nasicornis Marsh; top view. *a*, nasal opening; *b*, horn-core; *c*, antorbital opening; *c′* cerebral hemispheres; *d*, orbit; *e*, lower temporal fossa; *f*, frontal bone; *h*, supra-temporal fossa; *j*, jugal bone; *m*, maxillary bone; *m′*, medulla; *n*, nasal bone; *oc*, occipital condyle; *ol*, olfactory lobes; *pf*, pre-frontal bone; *pm*, pre-maxillary bone; *q*, quadrate bone; *qj*, quadrato-jugal bone.

NEW JURASSIC DINOSAURS.

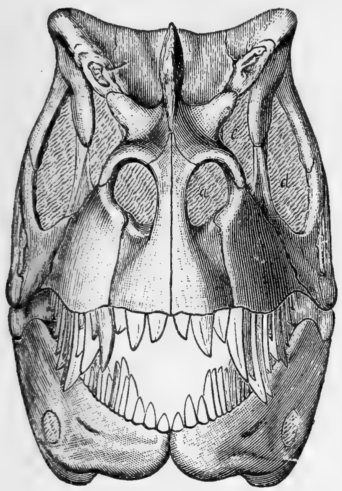
IN the *American journal of science* for April, Professor Marsh has given the principal characters of the Theropoda, a carnivorous order of dinosaurs, illustrated by numerous figures, several of which are here repeated.

Although much has been written about these reptiles since Buckland described Megalosaurus, in 1824, but little has been made out in regard to the structure of the skull, and many portions of the skeleton still remained to be determined.

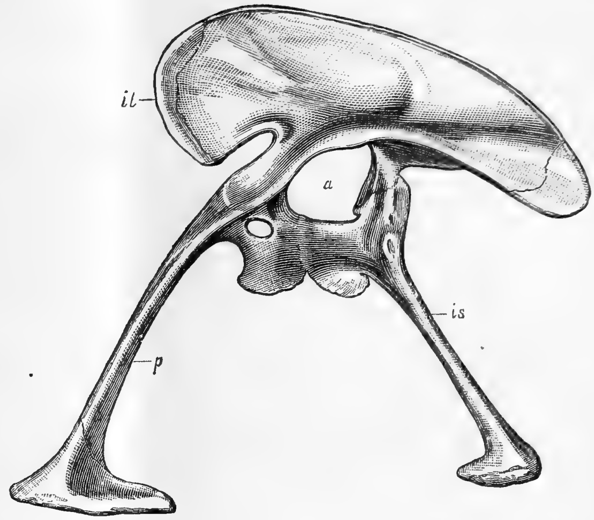
Of the carnivorous dinosaurs from the American Jurassic, there are apparently four distinct families, one of which is represented by Ceratosaurus, a new form here described. The nearly perfect skeleton of Ceratosaurus presents several characters not hitherto seen in the Dinosauria. One of them is a large horn on the skull; another is a new type of vertebra; and a third is seen in the pelvis, which has the bones all co-ossified, as in all known birds except Archaeopteryx. Another feature, not before known in carnivorous dinosaurs, is the presence of osseous dermal plates, extending from the skull over the vertebrae. This skeleton is over seventeen feet in length.

The skull of Ceratosaurus is very large in proportion to the rest of the skeleton. The posterior region is elevated, and moderately expanded transversely.

The facial portion is elongate, tapering gradually to the muzzle. Seen from above, the skull in out-



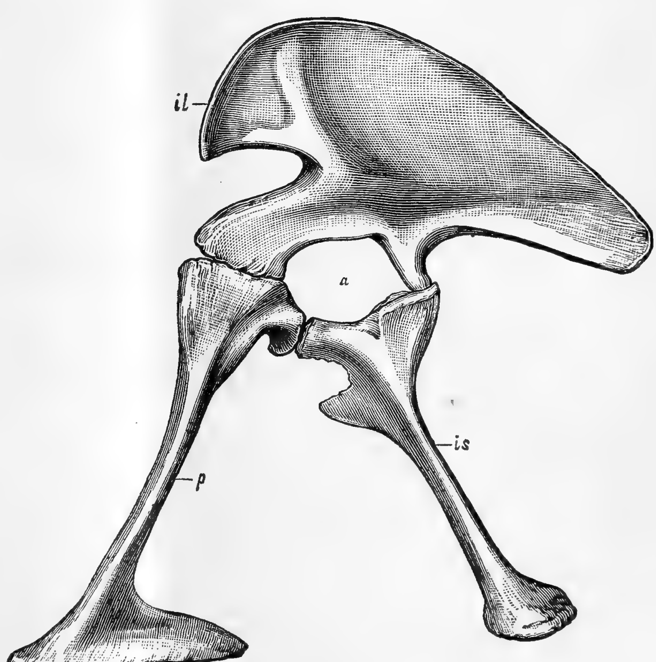
Skull of Ceratosaurus nasicornis Marsh; front view.



Pelvis of Ceratosaurus nasicornis Marsh; side view, seen from the left. *a*, acetabulum; *il*, ilium; *is*, ischium; *p*, pubis. One-twelfth natural size.

line is like that of a crocodile; seen from the side, it appears lacertilian in type, the general structure being light and open. The nasal bones support a large, compressed, elevated horn-core on the median line. It evidently supported a high trenchant horn, which must have formed a powerful weapon for offence and defence. The maxillary bones are large and massive, as are also the lower jaws. They are each provided with numerous teeth, which are large, powerful, and trenchant, indicating clearly the ferocious character of the animal when alive. There are, moreover, large protuberances partially overlying the orbits, which they doubtless served to protect. The brain was of medium size, but comparatively much larger than in the herbivorous dinosaurs: it was quite elongate, and situated obliquely in the skull. The foramen magnum is small. The cerebellum was of moderate size. The optic lobes were well developed, and proportionally larger than the hemispheres. The olfactory lobes were large and expanded. The pituitary body appears to have been large.

The cervical vertebrae differ in type from those of any other known reptiles, being deeply concave behind, but flattened in front, leaving only a narrow margin for articulation.



Pelvis of Allosaurus fragilis Marsh; side view, seen from the left. *a*, acetabulum; *il*, ilium; *is*, ischium; *p*, pubis.

The bones of the pelvis, except the sacrum, are all thoroughly co-ossified. The pelvis is extremely narrow, being in striking contrast to the width in this region in the herbivorous forms found with them. Some facts seem to indicate that they were viviparous. The pubes were long, and firmly united for the greater part of their length, terminating below in a large, massive, foot-like body, which probably served to support the animal when sitting down.

Restorations of the fore and hind legs of Allosaurus are given. They are remarkable for the great disparity in size. A new classification of the order Theropoda is also proposed, including the European as well as the American forms.

THE ASTRONOMICAL LABORS OF MR. COMMON.

In his address before the Royal astronomical society in February last, on the presentation of the gold medal to Mr. Common for his photographs of celestial bodies, the president of the society, Mr. Stone, remarked that the council, in making the award, had been less influenced by originality in the methods adopted than by the great practical success which has attended his efforts in this field of astronomical research. It will be of interest to note a few points, relating to the labors of Mr. Common, which have contributed more or less directly to the importance of his results.

He began celestial photography about ten years ago, with a small refractor of five and a half inches aperture. In 1877 he supplied himself with an eighteen-inch mirror by Calver, the mounting for which was designed by himself, and executed under his direct personal superintendence. In a paper presented to the Royal astronomical society in 1879, he laid down certain assumedly proper conditions to be fulfilled in the mounting of large reflectors, according to which he was proceeding with the construction of an exceedingly powerful telescope, and among which were the following: —

1°. No tube properly so-called. 2°. No mass of metal either below or at the side of the line joining the large and small mirrors. 3°. An equatorial mounting capable of direction to any part of the visible heavens, and of continued observation past the meridian without reversal. 4°. An efficient means of supporting the mirror without flexure. 5°. Driving-clock, circles to find or identify an object, and motions taken to eye-end. 6°. A collimator for the ready adjustment of the mirrors. 7°. Such a construction of mounting as to give the greatest amount of steadiness with the least amount of friction. 8°. An efficient means of resilvering the mirrors and of protecting them from dew. 9°. A safe, steady, and easily adjusted platform for the observer, allowing about two hours continuous observation without the necessity of any motion except that from the observer's place, and of easy access.

In designing a mounting to satisfy these conditions, Mr. Common made such departures from the old form of mounting and platform, that an account of it was deemed worthy of a place in the Memoirs of the Royal astronomical society, where may be found (vol. xlvi. p. 173) a description of his instrument, together with fully detailed drawings suited not only for his, but also for a much larger telescope. In the actual construction of the thirty-six inch reflector, the cost was kept down as much as possible without sacrificing any essential points, all elaborate mechanical arrangements coming under the head of mere luxuries being avoided. Both the telescope and its house were so contrived as to be completely under the management of one person.

The difficulties which Mr. Common surmounted in the construction of his telescope were of the most discouraging nature, — in fact, unique. Just as the great speculum — a lump of glass of about thirty-eight inches diameter, and seven inches thickness — was ready to receive its final figure in the hands of the optician, it burst into a thousand pieces with a terrific explosion. Within a few hours time, Mr. Common had telegraphed to the glass-makers in Paris for two more disks of like dimensions, the extra one to be brought into service in case of another explosion. The second disk, however, was successfully ground, polished, and mounted ready for work, about the middle of 1879, and it is with this instrument that Mr. Common has carried on his unequalled researches. In some respects it is proper to call it the most powerful telescope in existence, although the great refractor of thirty inches aperture, now being mounted near St. Petersburg, may be expected to surpass it.

A description of Mr. Common's novel plan for silvering large mirrors may be found in vol. xlii. of the *Monthly notices* of the Royal astronomical society, at p. 79.

Of the mounting of Mr. Common's reflector, Mr. Stone remarks, that it shows in every direction great engineering-skill, guided by the experience, gained in the use of the smaller instruments, of the actual requirements for successful astronomical work. The method of relieving the friction of the polar or main axis of the instrument deserves especial attention, and is fully dealt with in his memoir. Mr. Common alluded, in this publication, to the fact that this principle is equally applicable to other astronomical instruments of large dimensions; and at the meeting of the Royal astronomical society, March, 1884, he presented plans for a large transit circle in which mercury-troughs are used to sustain the weight of the tube when in certain positions. By these means he believes that flexure may be practically eliminated.

Early in 1880 Mr. Common attempted to photograph the great nebula of Orion; the result being a failure, as the stars appeared on the plate as lines, and the nebula had impressed itself only as a faint stain. But such failures only suggested the necessity of improved clock-driving, and the use of more sensitive plates. In June, 1881, Mr. Common obtained a successful photograph of comet (*b*) of that year; and, in March of the year following, a photograph of the nebula of Orion, which excited the admiration of all the astronomers who had an opportunity of inspecting it. He continued, however, to push the refinements of his photographic and instrumental equipment to a farther limit, and obtained on the 30th of January, 1883, a photograph of the nebula, with an exposure of thirty-seven minutes, a carbon enlargement from the negative of which was presented to the Royal astronomical society in the March following. This photograph showed a marked advance on

all his previous ones, and gave evidence of a time approaching when the shapes of nebulae, and the relative brightness of the different parts, will be recorded photographically in a better manner than by the most careful hand-drawings. The behavior of the very faint stars in the nebula also led to results of the greatest interest. These stars appear on his negatives taken with exposures of from thirty-seven to sixty minutes; and, as the time of exposure can be easily extended to hours, Mr. Common thinks it quite possible to get stars invisible to the eye in the same telescope used for photography. Mr. Common has already experimented with the longer exposures, and more details are brought out with every increase of the time; and it appears that the extreme limit of useful exposure has not even been reached at an hour and thirty minutes.

Mr. Common has also obtained beautiful photographs of other nebulae and of the planets Jupiter and Saturn, and has also applied himself successfully to obtaining photographic star-maps to stars of the eleventh magnitude.

In connection with all this variety of valuable astronomical work, it should be noted that Mr. Common belongs properly to the ranks of amateur astronomers; and this fact was dwelt upon at some length by Mr. Stone, at the conclusion of his address, as follows: —

"The lesson taught is not a new one. The records of our society are rich in the labors of our amateur astronomers. The amateur who can provide himself with sufficient instrumental means for original research need fear no professional rivalry. Untrammelled by the necessity of continuing observations whose value largely depends on their continuity, having the power of taking up any subject he pleases, without fear or responsibility of charges of wasted time and wasted means, he possesses advantages which are priceless in the tentative and experimental stages of any work.

"It is in work of this class that the most striking advantages in our science must be expected; and such work will most certainly repay, by the gratification of personal success, the efforts of those who devote themselves to original work in our science; and the field of research presented is absolutely boundless."

INSECTS AND FERMENTATION.

THANKS to a long line of investigators and experimenters, beginning with Sprengel, and including among its recent leaders Darwin and Hermann Müller, we know that very intricate relations exist between flowering plants and insects which result to the advantage of both; many insects obtaining their food exclusively, or in large part, from the nectar and pollen of flowers, which are strengthened by intercrossing as a result of their visits. Within the last few years the activity of insects has also been shown to have a close connection with the distribution of other and lower organisms. The fetid slime of phalloids has long been known to be attractive to many flies and scavenger-beetles; and, as Mr. Gerard suggests in the case of the common stinkhorn (Phallus impudicus), the dissemination of these fungi is largely traceable to such insects. Rathay has likewise shown that a partnership of a somewhat similar nature probably exists between some of the rust fungi (Roestelia, Aecidium), and insects which feed upon the sweet secretion that accompanies their spermatia. In these cases the arrangement appears to be mutually beneficial. In the last it may also favor the spread of diseases of the higher plants, and so lead to important indirect results. Zymotic diseases of man and the domesticated animals are also known to be carried by the same active agents, which, however, appear to be rather accidental than specially provided for; while, in the asserted intervention of mosquitoes in the parasitism of Filaria, they are decidedly losers by their part in the transaction.

Boutroux has recently shown [1] that insects also play a very important, if indirect, *rôle* in the life-history of yeasts. It has been generally asserted that the agents of spontaneous fruit-fermentations, like those employed in the manufacture of wine and cider, are found on the surface of the ripe fruit, whence they readily reach the expressed juice. Boutroux was led to investigate their occurrence not only on ripe fruits, but on those which were immature, as well as in the saccharine secretions of flowers and on the bodies of the insects which visit both classes of objects. He prepared tubes of sterilized cherry-juice, or other fermentable liquid, from which germs were excluded by means of cotton. After these had shown their freedom from yeast by remaining unchanged for a fortnight, at a temperature favorable for fermentation, a fruit, flower, or insect was introduced into each, precautions being taken to prevent the introduction of germs from other sources. Repeated transfers were made from these first propagation cultures, where several species were usually found, until these were isolated, when their form and physiological characters were studied.

Contrary to the prevalent opinion, it was found that ripe fruits, as long as they are intact, bear comparatively few yeast-germs, these being much more frequent on green fruit, as well as in the nectar of flowers and on the bodies of the insects which are common about flowers. From what appears to have been a careful series of experiments, Boutroux advances the opinion that these spontaneous yeasts are regular inhabitants of nectar, being carried from flower to flower by insects in their visits for this beverage. After the fading of the flower, especially where some of its organs persist on the ripening fruit, they remain, the number of germs suffering constant diminution from rain and other causes. When the fruit has ripened, a few of these germs may still be present; while others are brought from later flowers, or from injured and fermenting fruit, by insects which feed upon the juices of the latter. The hibernation of these species is thought to occur on the remains of fallen fruit, as well as in the ground, whence a new supply is obtained the next spring. It is interesting to note that the species which have been obtained in these cultures are not identical with the wine and cider ferments, although some of them resemble these closely; and it is suggested, that, while

[1] *Ann. des sci. naturelles, Bot.*, 6 sér., v., xvii., p. 144.

these species are undoubtedly derived from the surface of the ripe fruit, their germs are extremely rare, though capable of rapid multiplication when once introduced into the must. W. TRELEASE.

THE VARIATION OF TEMPERATURE IN GERMANY.[1]

DR. HELLMANN has, by this paper, added another to the already large list of climatological contributions which have appeared in the German language. Such papers can and ought to serve as models for the uses to which the data secured in our own country should be put; and although we may have no particular interest in the climatical relations which exist in a certain part of Europe, yet each paper of the nature of the present should be carefully examined as to method, if not for results.

In 1874 there was given in this same publication an article on the climatology of Germany; and this contained the mean temperature for the twenty-five years from 1848 to 1872 of the stations connected with the Prussian meteorological institute. Hellmann has made a new discussion of these temperatures, and has included in this the ten years extending from 1872 to 1882. He has chosen to put the observations into five-day periods; and, using these means in his discussion, he proceeds, by means of combining certain stations, to show what deductions he can draw from the material at his disposal. The twenty-five stations he divides into seven districts, which have recognizably different meteorological conditions; and these stations are quite evenly distributed. Of the twenty-five, only ten were complete in their meteorological data; but the lacking observations have been filled in, and the error of this reduction will not exceed 0.2° C. Hellmann then proceeds to give the missing dates for the various stations. The observations were made at six, two, and ten, with one exception; and he deplores the fact that the lack of good hourly observations does not allow the reduction of these to a true daily mean. The temperatures for the various places are plotted, and curves drawn, on the same page, so that they can be easily compared with each other; and the curves are, in general, similar. The author brings out the fact that "unperiodic weather characteristics are not of a local nature, but occur at the same time over large areas." He also shows that the yearly extremes increase as we proceed inland. With three exceptions, the coldest weather occurred in the five days between Jan. 11 and Jan. 15, but the warmest weather does not occur in all at the same time: this varies from July 17 to July 27. Hellmann goes into a detailed discussion of this difference and the reason. He remarks that Wargentin, in 1760, was the first to use the mean temperature for five-day periods in showing the yearly rate. The temperature-curves of Breslau for ninety-two years and for thirty-five years are compared. An interesting table is given in which the probability is computed that each succeeding five days will be colder from January to August, and warmer from August to January. The periodic return of colder weather is carefully examined and commented on in detail.

At the end of five pages of text we find six pages of tables, containing the five-day means for each of the stations from 1848 to 1882; then comes the graphical representation of this as already mentioned, and next a number of curves showing the relations of the air-pressure, temperature, rain, and probability of succeeding cold at Breslau from 1848 to 1882, and then curves showing the temperature for May and June for Breslau for each year of this same period.

F. W.

[1] *Ueber den jährlichen gang der temperatur in Norddeutschland.* By DR. G. HELLMANN. From the *Zeitschrift der Königlich preussischen statistischen bureau's, jahrgang* 1883.

LOUIS PASTEUR.

M. Pasteur. Histoire d'un savant, par un ignorant. Paris, *Hetzel*, 1883. 14+392 p. 16°.

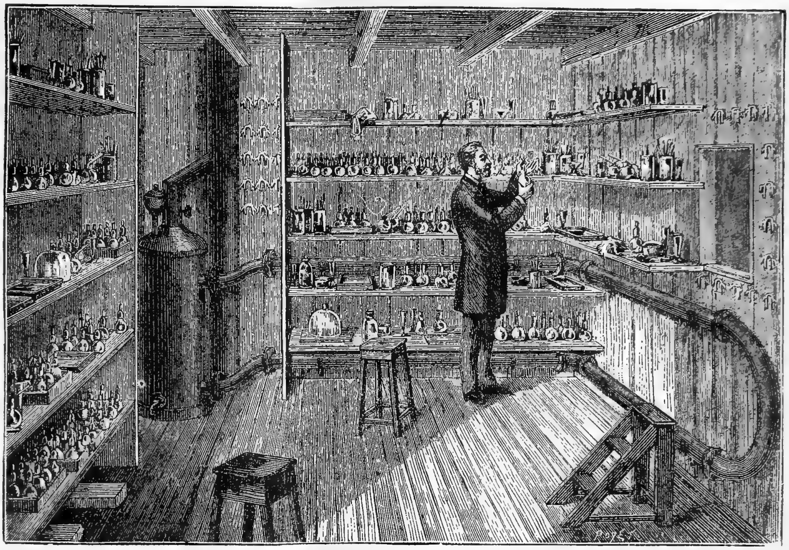
IT is the fashion at present to tell the unfinished histories of living men. Noteworthy literary characters have been of late studied, weighed, almost vivisected; and now science pauses to listen to the life-history of one of her living masters. Let us be thankful, however, that we are not yet asked to take the measure of our friend before his death. On the contrary, we are only invited to draw our chairs about the fireside, while a mutual friend discourses to us, half aloud, and half in confidence, about the man and the scholar, Louis Pasteur.

The book whose title stands above has caused much comment on the continent and in England; so much, indeed, that an English translation is already announced, for which, rumor has it, we are indebted to Professor Tyndall, always a warm admirer of Pasteur. Some of the Parisian correspondents of journals published elsewhere have apparently been much impressed by the book, and have written elaborate reviews of it.

The author of this little history modestly professes to be '*un ignorant*,' whose only merit is that he appreciates the master. On laying down the book, we cannot believe that he really deserves his chosen title, for he has certainly mastered the master himself. However, we shall not quarrel with him, especially since he is now known to be the son-in-law of Pasteur, but shall rather thank him for the labor of love and enthusiasm which he has done so well. As has been hinted above, the author has given a familiar account of the life and labors of Pasteur. The book is not a 'critical examination:' it is, rather, a fascinating story. Of course, from the rigid scientific stand-point, it is one-sided and partial. Objectors and ob-

jections are seldom adequately recognized and met. Liebig gets fuller treatment than most; while Schützenberger, Koch, and Berthelot are either passed with a light touch or altogether ignored. Much of the story gives the impression of a comparatively quiet and always triumphant life, flowing smoothly on, — a stream of brilliant scientific conquest, unrippled by blunders, and unchallenged by the incredulous. But the initiated know that the course of true science, like that of true love, never runs smooth, though both are probably all the more interesting on that account.

Louis Pasteur was born in Dôle, Dec. 27, 1822. His father, who had been an honorable soldier, had settled down as a tanner, but he appears to have had an earnest desire that his boy Louis should become a scholar. "Ah!" said the father over and over again to the young boy, "if you could only become a professor some day, and a professor in the college of Arbois, I should be the happiest man in the world." Little did the father think that his son would be professor — not at the humble Arbois, but in the École normale de Paris.



THE WARM ROOM FOR THE CULTURE OF MICROBES.

In 1842 young Pasteur was examined for entrance to the École normale. He was admitted, but stood fourteenth; whereupon he voluntarily spent a year in more careful preparation, and then, in 1843, entered the École, now standing fourth among the candidates.

Chemistry had already become a passion with him; and under Dumas at the Sorbonne, and Balard at the École, he had ample opportunity for following his bent: "M. Dumas, with his serene gravity, . . . never letting the least inaccuracy slip into his words or his experiments; M. Balard, with boyish vivacity, . . . not always giving his words time to follow his thoughts."

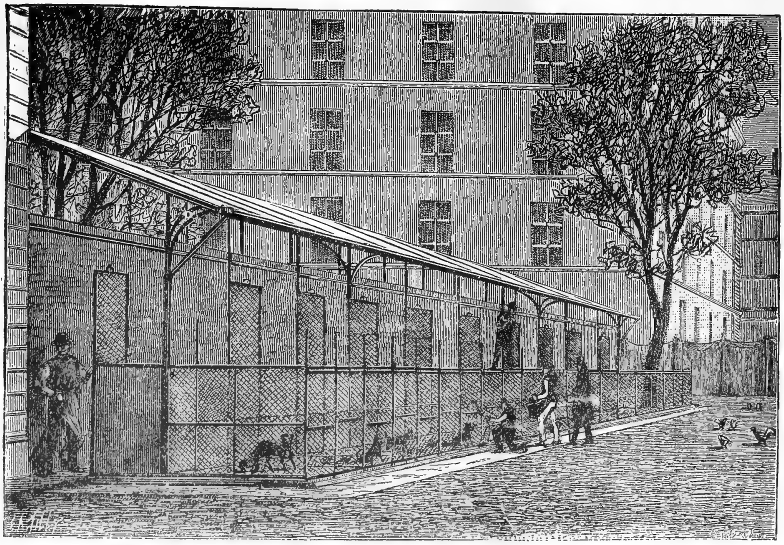
Under Delafosse, Pasteur now became absorbed in molecular physics, and finally met with an anomaly pointed out by Mitscherlich; viz., that while the tartrates and paratartrates of sodium and ammonium are in nearly all respects alike, they yet act differently upon polarized light. This anomaly fastened itself in the fresh mind of Pasteur, and eventually led him to his views on dissymmetry, which are here given at great length.

While still absorbed in molecular physics, Pasteur was appointed assistant professor at Strasbourg, where he carried on the same studies. "To interrupt these required nothing less than his marriage with Mlle. Marie Laurent, the daughter of the rector of the academy. Indeed, it is said, that, on the morning of the wedding-day, some one had to go to the laboratory to remind M. Pasteur that it was the day on which he was to be married." The author assures us, however, that he has proved to be so good a husband, that Madame Pasteur listens to the story now with an indulgent smile.

In 1854 Pasteur was appointed dean of the faculty of sciences at Lille. He was then thirty-two years of age, and almost wildly enthusiastic over molecular physics. But as a matter of policy, for the sake of drawing the attention of the neighborhood to the new faculty, he resolved to lecture, for at least a part of every session, upon fermentation, because the making of alcohol was a prominent industry thereabouts.

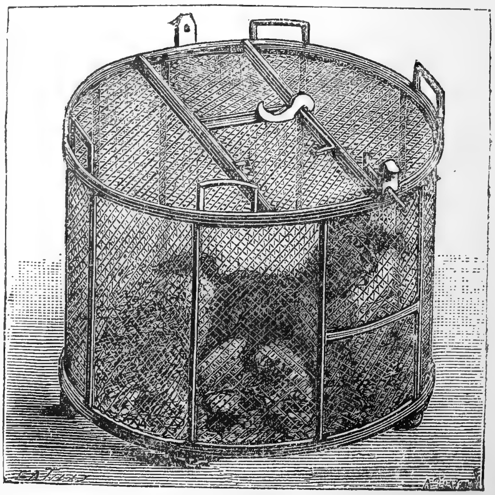
From this time on, Pasteur's history is more familiar. Fermentations, spontaneous generation, wine, vinegar, the silk-worm disease, splenic-fever, chicken-cholera, hydrophobia, and vaccination have been successively studied by him, and many of them much elucidated.

In the present volume their history is given in very interesting detail, which, however, time does not permit us to consider. By no means all of his views are accepted or acceptable; but in the distinguished professor — now of the École normale, and Membre de l'Institut — we have a very brilliant example of a man of science who has finally attained great and deserved fame. If its coming was slow, it was sure; and scientific men have often had to wait for '*le grand public.*'



KENNELS FOR MAD DOGS.

The last chapter of the book describes the biological laboratory of the École normale. Under Pasteur's control, its funds have been made ample by the liberality both of the government and of the municipal council of Paris. The garden of the old Collége Rollin has been placed at his disposal; and here Pasteur has provided stables for horses having the glanders, sheep-pens for sheep attacked by splenic-fever, and kennels for dogs mad with rabies. In the cellars beneath his laboratory in the Rue d'Ulm dwells a shifting population, a sort of unhappy family of animals undergoing experiment. The author dryly remarks, that the mad dogs are not particularly re-assuring to the spectator, as they furiously bite the iron bars of their cages. While some, however, are furious, and given to lugubrious barking, others are still unconscious of the fatal germ that is developing within them. Here are families of fowls, rabbits, guinea-pigs, and little white mice, all destined for inoculation experiments. Every morning a tour of inspection is made, and the dead are removed to the rooms above for dissection and examination. Some of the animals are also brought up from time to time for vivisection. But in Pasteur's laboratory 'every vivisected dog is a chloroformed dog.' He states very emphatically, however, that, though he "would never have the courage to kill a bird for sport, in the cause of science he has no scruples." Distributed about the laboratory and offices are panniers and boxes, some of great size, wrapped in straw, and containing the carcasses of animals (sent from all parts of France, and, indeed, of the world) which have died of various diseases. In fact, there seems to be a regular delivery at the laboratory, not only of these Christmas-like hampers, but of small tin boxes and carefully packed phials, containing such precious gifts, by foreign *savants*, as yellow-fever secretions from Brazil, or possibly cholera-germs from India. Perhaps the most curious sight is the large number of glass tubes distributed everywhere through the laboratory. In the solutions contained in the tubes, swarm millions and mil-



CAGE FOR A MAD DOG.

lions of microbes in various stages of 'attenuation;' and a prick from a pin-point dipped in any one of them might confer a horrible disease or future immunity from it. Yet in the midst of such dread possibilities the devoted experimentalist moves unharmed.

The closing paragraph runs as follows: "At this very moment experiments [upon the prevention of hydrophobia] are under full headway. Biting dogs and bitten dogs fill the laboratory. Without reckoning the hundreds of dogs which within three years have died mad in the laboratory, there is not a case discovered in Paris of which Pasteur is not notified. 'A poodle and a bull-dog [*bouledogue*] in the height of an attack; come!' was a telegram sent to him recently." Pasteur went, and took our author with him. The two dogs were rabid '*au dernier point*,' and it was only after some time and no small trouble that they were bound securely to a table. M. Pasteur then bent over the frothing head of the bull-dog, and sucked into a pipette a few drops of saliva. Our author remarks, in conclusion, that Pasteur never appeared to him so great as in the cellar where this took place, and while this '*tête-à-tête formidable*' was being enacted.

PLANTÉ'S RESEARCHES.

Recherches sur l'électricité, de 1859 à 1879. Par GASTON PLANTÉ. Paris, *La lumière électrique*, 1883. 5+322 p. 8°.

THE great interest taken in electric accumulators since Faure brought out his secondary battery, in 1881, has doubtless led to this reprint of Planté's researches from the text of the first edition, published in 1879, and two supplementary papers issued a few months later. These researches, extending over a period of twenty years, are characterized by a neatness and originality that make them very attractive. The writer considered himself specially fortunate in receiving a cordial invitation from M. Planté, in 1881, to witness many of the most interesting experiments described in this book. A review of them recalls vividly the pleasure experienced in Planté's laboratory, near the celebrated 'Place de la Bastille.'

A *diplôme d'honneur* was most worthily conferred on M. Planté at the Paris exposition of electricity, in recognition of his labors as the inventor of the secondary battery; for, while polarization currents had been observed by other physicists previous to the beginning of his work in 1859, no one had pursued the investigation with sufficient patience to make the principle of any special value. It is entirely safe to say now, however, — in view, too, of all that inventors have done within the past three years, — that no one can make a special study of secondary batteries, or succeed in making efficient ones, without going to these researches of Planté for the most essential part of his information. As a purely experimental series, they must take rank with the best in the domain of physics.

It is to be regretted that M. Planté has not revised those portions of his researches relating to the chemical reactions taking place during the charging of the cell and its discharge. His explanation of the formation of the peroxide of lead on one plate, and of spongy lead on the other, has the merit of simplicity at least; but, in the light of Gladstone and Tribe's[1] investigations, it must be considered as entirely too simple to accord with the facts. No mention is made, in these researches, of the formation of lead sulphate; and yet its presence is fully established, and the part it plays in local action is clearly demonstrated. The slow conversion of the peroxide into sulphate on the negative plate, with the circuit open, explains the gradual fall of electromotive force; while the residual charge appears to be fully accounted for by the two related facts of the formation of a small amount of peroxide on the positive plate during the discharge, producing electrical equilibrium before the peroxide on the negative plate is exhausted, and the subsequent conversion of this peroxide into sulphate, thus reestablishing a difference of potential. The formation of highly resistant sulphate from peroxide on the negative plate, and from metallic lead on the positive, accounts for Planté's observation that a cell long disused acquires great internal resistance, and charges again with difficulty. It seems highly probable, however, that the skill acquired by Planté in 'forming' his cells enables him to so modify the physical character of the surfaces of the lead plates that the sulphate plays a less important part in the final chemical action in his cell than it does in the experiments of less skilled physicists. Thus Professor Barker says of one of his Planté cells, "Not a trace of sulphate has been formed in it apparently, though it has been in use for six months."[2]

It would be pleasant to express as high an opinion of M. Planté's explanations of electrical phenomena in nature as of his researches: but this is impossible; for while he gives a possible explanation of ball-lightning, and other

[1] *Nature*, xxv. 221, 461; xxvi. 251, 602.
[2] *Proc. Amer. assoc.*, xxxi. 217.

forms of electric discharge from the clouds, it is none the less unsatisfactory to be told that atmospheric electricity arises from the earth's possessing a constant positive charge. Again: the theory that the sun is only one of a *chapelet de grains brillants* originally fused by a powerful current like the globules formed by a melting wire, and that "the incandescence of the solar globe, prolonged during a long series of ages, is itself only a spark of short duration in the infinity of time and space" (p. 250), is not worthy to stand in connection with the account of his many remarkable investigations. These furnish no basis for such a speculation, and scarcely more for the theory that "whirlwinds and cyclones are the powerful electro-dynamic effects produced by the combined forces of atmospheric electricity and terrestrial magnetism" (p. 229).

In conclusion, M. Planté says, respecting the nature of electricity, that it "may be considered as a motion of ponderable matter, — motion of transport of a very small mass of matter, animated by a very great velocity if an electrical discharge is considered, and a very rapid vibratory motion of the molecules of matter if its transmission to a distance under the dynamic form, or its manifestation under the static form, at the surface of bodies, is considered" (p. 314). Without adopting this view, we may say that many of Planté's experiments strongly support it.

THE CHILIAN LANGUAGES.

Chilidúgu sive tractatus linguae chilensis. Opera BERNARDI HAVESTADT. Editionem novam immutatam curavit Dr. JULIUS PLATZMANN. 2 vols. Lipsiae, *Teubner*, 1883. 952 p. 12°.

THIS is the general title of Platzmann's neat facsimile reprint of an important publication of the eighteenth century which had become quite scarce. Havestadt was a Jesuit, born in the environs of Cologne, on the Rhine, and a man of considerable learning, — a fact which appears not only from the fluent and elegant Latin style in which his manuals are composed, but also from the few leaves which he devotes to an autobiographic notice. The travels performed by him (1751–52) in his Chilian diocese on the western slope and in the higher valleys of the Andes are described in vivid colors by himself, and illustrated by a quaint map, which fully deserves the attention of ethnographers. The missionary's work was originally published (in 1777) with several sub-titles, which are faithfully reproduced in the reprint with all the saints' images, heraldry, etc., and embrace the following parts: Chilian grammar; three vocabularies; catechism, with Latin translation, and hymns in Chilian, to which music-notes are added; and a diary.

The phonetic system of Chilidúgu (*dúgu*, 'language') is described with laudable accuracy by the padre, who marks forty different sounds as constituting its alphabet. The language evinces some tendency towards nasalization of the consonantic elements, but is of an easy and harmonious pronunciation, and shows some general resemblance to Quichhua and Aimará phonetics. A peculiarity not very often found in American languages is the dual, which here pervades the verb and pronoun as well as the noun. According to the custom of his epoch, Havestadt arranged the forms discovered in this southern language wholly after the pattern of the Latin grammar. He found six cases in the noun; but his paradigms conclusively show that his nominative is identical with his accusative and vocative, his dative the same form as his ablative. Whether these cases are formed by postpositions, or by real case-affixes, remains to be examined. The verb inflects with remarkable regularity, forms five tenses and an intricate array of verbals (nominal forms of the verb, gerunds, etc.), has an interrogative, affirmative, negative, and passive form, together with an extensive system of transitions. A large number of suffixes serves to form derivatives, verbal as well as nominal, from verbal and nominal bases. In his rich collection of conversational phrases, the author has given a powerful and safe guide for the study of this sonorous tongue, which he extols in such a manner as to make it "surpass in excellence and graphic power all other languages of the world." The vocabularies given by Havestadt are more copious than that of Febres and the other authors who have written upon the Chilidúgu. The dialect of Chilidúgu, treated by Havestadt, is that of the Molu-che tribe.

THE IRON AND STEEL INSTITUTE.

The journal of the Iron and steel institute. Vols. i. and ii. London, *Spon*, 1883. 10+484, 405 p. 8°.

THE proceedings of the Iron and steel institute cannot fail to be of interest to the general scientific public, and especially so to the workers and manufacturers of iron and steel, since the society numbers among its active members such men as Sir Henry Bessemer, Mr. Sidney G. Thomas, and Mr. I. Lowthian Bell. The late C. W. Siemens was one of the prominent members and contributors. The

papers read and discussed at the meetings held during the last fourteen years cover not only the practical, but the theoretical ground of the iron-manufacture.

As its name indicates, this society confines itself to the consideration of iron and steel, and allied subjects. In the volumes before us we have sixteen papers, which, with the discussions, occupy 389 pages. There are 43 plates of illustrations. The remainder of the volumes, 400 pages in all, consists of notes on the progress of the iron and steel industries of the United Kingdom and of foreign countries. These notes are arranged for the different countries under the following heads: ores and fuel, blast-furnace practice, manufacture of steel, manufacture of iron, mechanical and physical properties of iron and steel, chemical properties of iron and steel, statistics. These notes contain also summaries of important papers in foreign publications.

The most valuable papers in these volumes, those on the temperature best for the greatest production of iron at least expense of coke, and on coke and gaseous fuel, have been noticed already in *Science*, Nos. 33, 50, and 59.

Vol. i. opens with a discussion on Mr. G. J. Snelus's paper on the physical and chemical characters of iron and steel. In view of the great increase of attention paid to this subject, the points of the discussion are worth a moment's notice. One of the more important points to be settled is the relation of the chemical composition and the physical treatment, hammering, heating, compression, etc., to the toughness and durability of steel used for rails and machinery.

The first researches on the subject seem to have been those of Messrs. J. T. Smith and Price Williams (*Proc. inst. civ. eng.*, 1875–76). The conclusion arrived at, that soft rails low in carbon resisted wear better than harder rails high in carbon, was contrary to the general opinion of metallurgists and engineers, which had been, that steel would wear better, the harder it was. C. B. Dudley's investigations in 1878 and 1880 (*Trans. Amer. inst. min. eng.*, vols. vii. and ix.) led him to advocate the use of soft steel for rails. The late Professor Grüner agreed with this view. But many engineers remained unconvinced; since, they argued, the rails tested might have had other causes of weakness than an unsuitable amount of carbon.

In the course of the discussion of Mr. Snelus's paper, M. Cazes, chief of the permanent way of the *Chemin de fer du midi de France*, gave some interesting tables, showing that the hard rails used on that road lasted much longer than those on the Cologne-Minden railroad, which have a composition more nearly approaching Dr. Dudley's proposed formula. There is as yet no commonly accepted measure of the work done by a rail. It is usually measured either by the tonnage borne or by the number of trains which have passed over it; but in nearly all estimates the speed of the train, which is an important element in the measure, has been left out of the consideration.

In view of all these discordant results, the physical side of the question is coming into prominence. It is said that a sudden cooling or a powerful compression favors the passage of the carbon into 'hardening carbon;' and upon this chemical effect of a physical cause, M. L. Clemandot's new process of tempering steel by compression is based. It is evident that many more experiments are needed before any satisfactory theory can be adopted.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Microscopic rock-investigation. — In addition to the microscopic examination of thin rock-sections being made in the various divisions of the survey, especially in the Rocky-Mountain division at Denver, and by Mr. R. D. Irving and his assistants in the Lake-Superior region, arrangements have been perfected to carry on similar work at Washington, under the direction of Mr. J. S. Diller, who has recently been engaged in arranging the machinery and appliances for this work. The work of cutting and grinding rock-specimens has been carried on by Mr. Newman, under the immediate supervision of Mr. Diller. It is also intended, in this connection, to make the photographic division available; and preparatory measures, with this object in view, are being taken by Mr. Hillers, the photographer of the survey.

Rocks of Lassen's Peak. — Last July Mr. Diller, before undertaking the reconnoissance of the Cascade Range, made a six-days' trip from Red Bluff, California, to Lassen's Peak (or Butte), and collected a number of interesting rocks; and of these Mr. Newman made thin sections, the microscopic study of which occupied Mr. Diller's time during January. They included basalts, hypersthene andesites, hornblende andesites, dacites, and basaltic and andesitic tufas.

Lassen's Peak is composed of dacite. This rock Richthofen considered to be typical nevadite, but Mr. Diller's investigations confirm Mr. Iddings's view that it is dacite. Gray dacite is abundant about the southern base of the mountain, in smooth cliffs and ledges, and has a remarkably gneissic appearance. Red dacite forms the summit of the peak, and a large portion of the northern rim.

Basalt has, perhaps, the widest distribution of all the rocks found in the vicinity of Lassen's Peak, and it is, as a rule, the most recent of the flows. An older basalt has been found in the stratified tufa, which forms great belts along the western base of the mountain. Between Red Bluff and Mill-Creek valley, south of Lassen's Peak, a distance of forty-five miles, wherever the surface is not occupied by tufaceous deposits, the rocks are basaltic. Lassen's Peak is an ancient volcano, and has poured out a great variety of lavas which are arranged in a most favorable position for a study of their succession.

Rocks of Mount Shasta and vicinity. — During a part of February, Mr. Diller was busy with the microscopic study of the metamorphic and eruptive rocks collected by him last season, along the Sacramento River north of the mouth of Pit River, and on Mount Shasta. The metamorphic rocks referred to consist mainly of augitic gneisses; and the eruptive rocks of the same region are, in part, gabbros. Some of the latter present peculiarities that cannot be positively determined until some chemical examinations have been made. The specimens have therefore been submitted to Professor Clarke for chemical analysis.

Mr. Diller has examined some thirty thin sections of rocks from Mount Shasta, and finds that they are divisible into three groups; viz., hornblende andesite, hypersthene andesite, and basalt. The rocks of Shasta are quite similar to those of Lassen's Peak, with the exception that the basalts of the former are much richer in olivine, and contain less globulitic base.

Crater Mountain (or Shastina), on the north-west spur of Mount Shasta, is composed of hornblende andesite; and through this, on the western slope, there has burst a large stream of hypersthene andesite which stretches far to the westward, towards Sissen's ranch, in Strawberry valley, on the Sacramento.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Engineers' club, Philadelphia.

April 19. — Mr. S. N. Stewart described a cushioned pier and rolling trunnion drawbridge. With a working model, he showed that a six-pound draw could be turned by a pennyweight pressure or a breath, and claimed, that, with a leverage six times as great as that of the model, twenty pounds pressure would turn a hundred-ton draw. —— Mr. William P. Osler presented, for Mr. J. Godolphin Osborne, an account of the Pocahontas mine disaster. He showed how probable it was that gas would have been detected by the engineers had it existed, and explained the method of damming and flooding the mine with 17,500,000 gallons of water to extinguish it; the latter being accomplished in sixteen days, one day being lost in repair of a dam. The cause of the explosion is, as yet, unknown. —— Mr. E. S. Hutchinson supplemented the above by an account of his recent visit to the mine, confirming, as far as he had observed, Mr. Osborne's opinion of damage to the mine. Timbers were displaced, cars demolished, etc.; but there was no fall of roof, except in the fan-entry, where much slate had fallen, but where a week's work would repair damage. He attributed the safety of the roof to the fact that from 12″ to 18″ of coal had been left as an elastic support to the treacherous slate above. He considered the presence of five or six inches of fine, dry coal-dust on the floor a phenomenon of special interest, and, while withholding a positive opinion in view of pending investigations by a committee of the American society of mining-engineers, he referred to a number of authorities to show the important bearing dust-explosions have upon safety in mines, like this, apparently entirely free from fire-damp. —— Mr. J. Foster Crowell announced that the new bridge of the Pennsylvania Schuylkill valley railroad, over the Schuylkill River at Manayunk, had just been completed, and noted, as a remarkable illustration of the vast strides made in American bridge-construction during the past few years, that so large and important structure as this is, being one-third of a mile in length and ninety feet high, can be reared and come into use without exciting special interest, or even deserving particular mention from an engineering point of view. —— The secretary read, from Mr. J. H. Murphy, a discussion of the switch formulae by Mr. John Marston. —— Mr. A. R. Roberts described a contrivance he had designed, by which a three-throw point switch can be operated from a single stand.

Linnaean society, New York.

April 18. — Mr. E. P. Bicknell read the third instalment of his paper, 'A study of the singing of our birds,' treating the Passeres to Astragalinus tristis in the same vein as the already published portions of this elaborate treatise. —— Mr. R. F. Pearsall called the attention of the society to the similarity of some of the notes of Parus atricapillus to those of Contopus virens, which accounted for the erroneous winter records of unseen individuals of the latter species. —— Mr. E. P. Bicknell related his spring observations for 1884 at Riverdale, N.Y., upon the first appearance of birds, flowers, etc. —— A communication from Judge Bicknell of New Albany, Ind., stated that the English sparrow flew from that city to the ripening grain-fields, and hence the reduction, by one-half, of the promised crop. Only a very slight indulgence in

insectivorous diet by this bird was noted by this vigorous writer. —— Dr. C. S. Allen mentioned the exhibition of a carnivorous propensity in the common barnyard duck, which he had seen catch P. domesticus, hurry with the struggling bird to the duck-pond, drown and immediately devour the victim, usually swallowing it whole. —— Dr. Allen placed on record the finding, June 15, 1881, upon the Island of Grand Menan, by himself and the late Dr. Edward Southworth, of the nest with four eggs of Empidonax flaviventris, the yellow-bellied flycatcher, built in the moss upon the north side of an inclination, partly covered over by moss, grass, and twigs. It was lined with the fine tops of grasses, cow's hair, and fine rootlets, and located in a soft, swampy spot, where there were few large trees. The male bird was not seen; but the female was almost caught by the hand, so closely did she sit.

Boston society of natural history.

April 16. — In a paper on the relation of the 'Keweenawan series' to the 'eastern sandstone' in the vicinity of Torch Lake, Michigan, it was pointed out by M. E. Wadsworth that the Keweenawan series was first established by observations made at Douglass Houghton Falls, near Torch Lake. These observations were supposed to show that the eastern sandstone lay horizontally up to the falls, and contained the *débris* of the supposed old seashore cliff over which the stream now fell. In 1880, Wadsworth showed that the eastern sandstone, instead of being horizontal, gradually dipped, as the falls were approached, to the north-west, the dip increasing from five degrees up to twenty-five degrees at the falls. He then pointed out that this sandstone contained old basaltic lava-flows intercalated with it, which explained the origin of the basaltic *débris* previously found here, and showed that the Keweenawan series and eastern sandstone were the same formation. In the third annual report of the director of the U. S. geological survey, the correctness of these observations have been admitted, with the statement that at some distance below the falls the rocks were found to be covered, and that Wadsworth bridged in his imagination the gap between the sandstones dipping five degrees and those above having a steeper dip. The lower ones are said to be the true eastern sandstone, and those nearer the falls to belong to the Keweenawan series, while they were separated by a hypothetical seashore cliff inserted in the covered space. To this Wadsworth replied, that, by digging in the stream and on the banks of the ravine, he had actually traced (not imagined) the relations of these rocks, going from those dipping five degrees up to those dipping twenty-five degrees, and that they were seen to form a continuous superimposed series, no such cliff as imagined existing between them. Wadsworth had also shown, in 1880, that the eastern sandstone was exposed on the Hungarian River up to its junction with the Keweenawan series. On this stream the sandstone had a varying dip from ten to twenty degrees to the north-west; and, although sometimes dipping in all directions, the prevailing one was north-west. At the junction, the sandstone was baked and indurated by the first basaltic lava-flow of the Keweenawan series, which in its turn had been denuded, and its *débris* built into a conglomerate, forming the fifth fall of the river. In the above-mentioned report, doubt was thrown on these observations by the statement that the observed sandstone was a loose piece, or, if not, the basaltic rock surely was, and that the prevailing dip of the sandstone was to the south-east. Wadsworth replied, that the dips given in the report appeared to have been taken from the frost-dislocated rock on the sides of the stream, while his were taken in the bed of the stream, when the water was exceptionally low. He further stated that the sandstone at the junction was continuous with that seen below; that it extended across the stream and into the banks on both sides; while the baking and induration of it showed that it must have been overflowed by some heated rock. Again: the basaltic rock extended across the stream into both banks, and was found to underlie the conglomerate, and that he dug the *débris* of the former out of the overlying base of the latter. All this, he said, showed conclusively that these rocks were *in situ*, and proved that here the eastern sandstone and Keweenawan series were one and the same; also that this series could not be maintained, as first established. He further pointed out that the claim advanced by many geologists, that the eastern sandstone did not contain the *débris* of the porphyry conglomerates of the Keweenawan series, was entirely opposed to the views of the same observers, that the eastern sandstone was younger than that series, and made out of its *débris*.

Appalachian mountain club, Boston.

April 9. — A paper by Prof. W. W. Bailey, on the west Humboldt Mountains, Nevada, gave some experiences of the author while attached to the U. S. geological survey. He explored Wright's cañon, and noticed the extraordinary effect of diurnal evaporation, the streams entirely disappearing during the heat of the day. The flora of the Buena Vista and Coyote cañons, on the eastern side of the Sierra Nevada, was found to be very distinct from that of the western side of the range. —— Rev. Luther Farnham gave accounts of three visits to the White Mountains, in 1837, 1862, and 1883. —— Mr. R. B. Lawrence gave accounts of the explorations of the southern Alps of New Zealand by Messrs. Green, Haast, and Van Lendenfeld.

Academy of natural sciences, Philadelphia.

March 22. — Prof. Edward D. Cope presented the results of his study of material illustrating the various forms of mastodon. He believed he could distinguish nine species from American formations, while those of other countries would probably bring the number up to eighteen or twenty. There are probably two genera. The oldest American mastodon comes from the upper half of the miocene, an assertion that one had been found lower down being undoubtedly incorrect. The division of the genera into two groups, founded upon dental characters, was sug-

gested, — one, represented by the Mastodon ohioticus, being characterized by the absence of inferior incisors; and the other, to which might be referred the genus Tetracaulodon, having these teeth.

March 27. — Dr. Joseph Leidy called attention to a specimen of a lizard, apparently Eumeces chalcides, which is remarkable for the small size of its limbs. They are, indeed, so small as to be almost invisible, thus giving the creature the appearance of a little snake; yet each limb has five well-developed toes. The specimen was from Petchaburi, Siam, where the natives regard it as a snake, and, as is common in such cases, consider it venomous.

April 1. — Dr. Joseph Leidy called attention to a mass composed of the tubes of Serpula dianthus from Barnegat Bay. The accumulation of the material is so great as to almost form a reef extending out from the bay. The locality is a famous one for sheep's-head-fishing, the fishes probably finding their food-supply in the worms. It was suggested that other marine animals may congregate there for the same reason, so that the locality is probably one specially worthy of the attention of zoölogical students. —— Referring to some observations of Kerner respecting the thawing-out of chambers in ice by living plants in the Alps of Europe, Mr. T. Meehan confirmed them by some observations made during the last winter on Eranthis hyemalis. At the end of January the plant was in flower after a few warm days, when a driving snow-storm prostrated the little stems, and covered them nearly a foot deep, in which condition they remained till early in March. After they had been three weeks in this condition, the snow was carefully removed, when it was found that the stems had become perfectly erect, a little chamber in the snow having been thawed out about each flower-stem. There was, however, no other evidence of growth. The few buds which were unopened when the snow came, were still unopened when the snow thawed away, after five weeks imprisonment; and the idea conveyed was, that plants would retain life without growth for an indefinite time, when under a low temperature, such as a covering of ice or snow afforded.

April 15. — Dr. Charles S. Dolley of Johns Hopkins university spoke of a form of so-called parenchymatous or interstitial digestion described by Korotneff as occurring in Salpa and Anchinia. It had been asserted that a large amoeboid cell existing in the intestines of these animals takes up the nutritive particles and passes them on into the tissues, and that in other related forms a plasmodium performs the same function. Dr. Dolley had observed the appearance in the intestines of Salpa, which had been described by the Russian author, but he would suggest an entirely different interpretation thereof. In Salpa we find a large branchial sac, representing the true pharynx, at the posterior portion of which is the stomach. The endostyle, or thickened bottom of a fold or groove of the branchial sac, throws out a supply of mucus, which covers the surface like a curtain, and in which nutritive particles finding their way into the animal are embedded. The food is carried back by cilia, and the mucous sheet is wound up into a thread, which can be traced into the oesophagus, and from there to the stomach. In Dr. Dolley's opinion, this mucous exudation is the amoeboid cell described by other observers, it having been found laden with nutriment in some three thousand sections of Salpa. When food is not present, the appearance indicated cannot be observed. —— Dr. N. A. Randolph described a test for the presence of small quantities of peptone in solution. If the acid nitrate of mercury (Millon's reagent) be added to a cold aqueous solution of potassium iodide, a red precipitate of mercuric iodide always appears. When, however, either peptone or the biliary salts are present in noteworthy amount, the precipitate of nascent mercuric iodide assumes the yellow phase. In order to render the test sensitive to the presence of minute quantities of the substances in question, he had found it necessary to limit the amount of potassium iodide employed. Thus, to each five cubic centimetres of suspected fluid, which must be cold and either neutral or faintly acid, are added two drops of a saturated solution of potassium iodide, the two liquids being well mixed. Four or five drops of Millon's reagent are now added, and the contents of the vessel well stirred or shaken. Under these circumstances, the presence of peptone in amounts of less than one part in five thousand is readily shown. By the exercise of great care in the performance of the test, he had been able to demonstrate the presence of peptone in a solution containing but one part of that body in seventeen thousand parts of water. The conditions interfering with this reaction are, alkalinity of the fluid examined; heat, which has the same influence upon the nascent mercuric iodide as have peptone and the biliary salts; and the presence of certain compounds, as potassium ferro-cyanide, which prevent the production of the mercuric iodide. The reaction described presents certain advantages from the fact that it is uninfluenced by the bodies usually found in the various organic fluids, although useless as an isolated test, inasmuch as it responds to two entirely different compounds, peptone and the biliary salts. —— Mr. Meehan referred to his former communications on the subject of the relation of heat to the sexes of flowers. He exhibited catkins and flowers of the European hazel (Corylus avellana) just matured, and which, for the first time in several years past, had perfected themselves contemporaneously. The past winter had been distinguished by a uniform low temperature the entire season. In other years a few warm days in winter would advance the male flowers so that they would mature weeks before the female flowers opened: hence the females were generally unfertilized, and there were few or no nuts. Under this law, it was evident, amentaceous plants could not abound to any great extent in countries or in localities favorable to bringing forward the male flowers before there was steady warmth enough to advance the female. He thought this was likely to be the reason why so many coniferous trees under culture in the vicinity of Philadelphia bore scarcely any fertile seed in their cones, — a fact which had often been remarked in connection especially with

the Norway spruce. The male flowers would mature before the female had advanced far enough to be receptive of the pollen. —— Mr. Meehan also stated that in his garden at Germantown, there were few trees that did not exude sap from wounds made in winter or early spring; but among them all, few bled, as it was termed by horticulturists, more profusely than Cladastris tinctoria. The icicles formed from this exuding sap afforded a good opportunity to test the saccharine character of the liquid. During congelation by frost, all foreign substances were rejected, and, in the formation of the icicle, the sugar was pushed forward to the extreme point. The end of an icicle of a sugar-maple was its only sweet part, and this was very sweet from the accumulation of the saccharine matter. The end of the icicle from the Cladastris was also sweet, though less so than in any other sugar-bearing tree he had observed.

Philosophical society, Washington.

March 1. — Gen. R. D. Mussey read a paper on the application of physical methods to intellectual science, discussing the extent to which those methods which have been successfully employed in the investigation of the phenomena of nature are applicable to the sciences whose subject-matter is mental operations. —— Mr. I. C. Russell followed with a communication on deposits of volcanic dust in the Great Basin. The sediments of the great quaternary lake of western Nevada, named Lahontan by Mr. Clarence King, include as minor members certain strata of white, unconsolidated, dust-like material closely resembling diatomaceous earth. Microscopic examination shows them to consist of minute shards of glass, and indicates their volcanic origin. Similar strata occur in the deposits of the quaternary lake which occupied the Mono basin, adjacent to the Lahontan; but these are coarser, and include fragments with pumiceous structure. Fragments of pumice are likewise found on the surface of the land in the vicinity of Mono Lake, and the distribution of these indicates their origin in a chain of rhyolitic cones extending southward from Mono Lake. The subaerial deposits belong to eruptions which, though prehistoric, must be quite recent. The sub-aqueous deposits were derived from quaternary eruptions. Those of the Mono basin can be referred, without hesitation, to the Mono craters; and those of the Lahontan basin are provisionally referred to the same source. Up to the present time, no other rhyolitic volcanoes of quaternary age have been discovered in the vicinity. Dr. T. Antisell remarked that the source of the volcanic dust should not be sought in existing volcanoes on the land: he regarded pumice as the product of submarine eruption exclusively. —— Mr. L. F. Ward read a paper on some physical and economic features of the upper Missouri system, describing the ancient and modern flood-plains of the Missouri and the Yellowstone where they issue from the mountains, and discussing the method of their formation. These are susceptible of irrigation; but diversion of river-water for that purpose, and its distribution over the land, involve difficult problems in political economy. The matter is a proper subject for governmental control. Discussion followed, in the course of which Prof. C. V. Riley remarked that the final solution of the grasshopper problem lies in the cultivation of the northern plains.

March 15. — Mr. G. K. Gilbert spoke on the diversion of water-courses by the rotation of the earth, maintaining, that, under certain indicated conditions, the deflecting force generally admitted to result from terrestrial rotation should result in observable modifications of valley configuration. —— Mr. G. E. Curtis read a paper on the relations between northers and magnetic disturbances at Havana, discussing the coincidences which had been pointed out, and demonstrating their accidental nature.

NOTES AND NEWS.

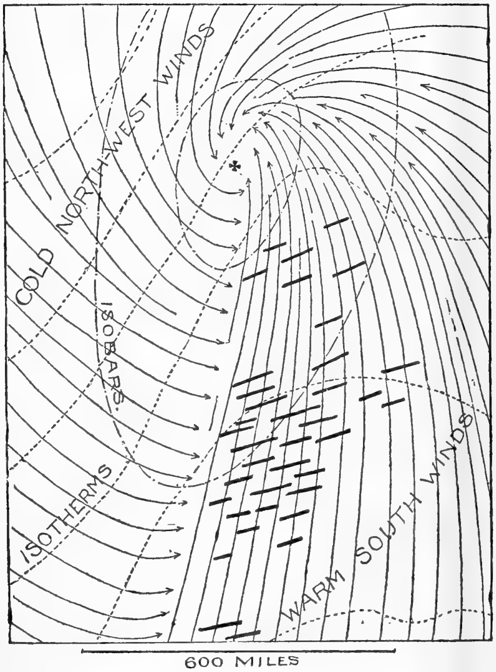
BY invitation of the authorities of the Johns Hopkins university, Sir William Thomson will deliver, in October next, a course of eighteen lectures on molecular dynamics, before the physical section of the Johns Hopkins university, beginning on Wednesday, Oct. 1. These lectures are intended only for students who are interested in advanced work. Professors and students of physics are invited to attend; and arrangements will be made by which they may easily obtain temporary lodgings, provided an early intimation is received of their intention to come. A registration fee of five dollars will be required.

— The Montreal local executive committee of the British association for the advancement of science is prepared to enroll ladies and gentlemen, residents on the continent of America, as members of the association, on the following conditions: 1°. Life members for a single payment of fifty dollars; 2°. Annual members for a payment of ten dollars the first year, and five dollars each consecutive year thereafter; 3°. Associate members for a payment of five dollars. Associates are not eligible to hold office in, nor to serve on any committees of, the association; nor do they receive the annual reports. All other privileges of membership for the year are open to them. No person who is not a member is admitted to any of the meetings of the association. The privilege of reduced fares by the railway and steamboat lines is limited to the life, annual, and associate members. Applications for admission to membership may be addressed to Mr. J. D. Crawford, post-office box 147, Montreal.

— Bliss's classified index to the maps in Petermann's *Geographische mittheilungen*, from 1855 to 1881, has just been issued by Harvard college library in advance of its completion, in the *Bulletin* of the university. It occupies fifty-five small quarto pages, and will be found exceedingly helpful to those using that treasury of excellent charts. The principal division is, of course, geographical; but many titles are conveniently repeated under the miscellaneous head,

including mainly meteorological, seismological, geological, botanical, and zoölogical maps. A reference-list to persons, expeditions, and surveys, is also appended.

— The third series of charts published by the signal-service, to illustrate the studies of tornadoes undertaken this year, represents the storms of March 25. Twenty tornado-tracks are mapped, scattered over the states south and east of Indiana. Their times are all in the afternoon or evening, and their courses, as usual, bear about east-north-east. The results of these disasters are at present counted thus: number of persons killed, 77; wounded, 298; valuation of property destroyed, $950,000. The contrast of the small, local tornado-whirls and the great sweep of the cyclonic circulation is clearly marked; and the attitude of the tornadoes, relative to the cyclone centre



and the warm and cold winds, is seen to be about the same as was shown on the earlier charts for Feb. 19 and March 11. The accompanying diagram is designed to show this relation in a general way, being based on an average of the three sets of charts. The nearly north-and-south elongation of the barometric depression is a departure from the more easterly trend of the major axis of the isobaric curves given in Loomis's averages; and this peculiar form is doubtless to be held in chief part accountable for the significantly abrupt change from the cold north-westerly winds of the western half of the cyclonic area to the warm southerly winds of the eastern half. The contrast of temperature thus produced is exhibited in the oblique trend and close approach of the isothermal lines, which are drawn for ten-degree differences. But most striking is the limitation of the tornadoes to that part of the warm southerly winds which is immediately overflowed by the cold winds, and the advance of the tornadoes, not with the surface-currents, but parallel to the spiral course of the cold blast overhead, through which the warm lower air ascends. The limitation of tornadoes to certain parts of cyclones, as thus shown, is a most hopeful sign, that, with longer and more detailed study, the smaller storms may, a few years hence, be predicted with as much accuracy as the larger ones are now.

— Prof. George F. Wright has contributed a good article on 'the Niagara gorge as a chronometer' to the April number of the *Bibliotheca sacra.* The conclusion is reached that the entire gorge from Queenstown to the Falls is the result of post-glacial cutting, and that the most probable rate of recession of the falls is about three feet a year; thus placing the end of the glacial period here about twelve thousand years ago. This agrees very well with the date determined by Prof. N. H. Winchell from the Falls of St. Anthony. The inconvenience to naturalists of having such an article as this stowed away in a theological magazine may be counterbalanced by the satisfaction they should feel on learning that it could be accepted there at all.

— Arrangements have been completed for holding at the university library, Berkeley, Cal., during the last week of May, a loan exhibition of books illustrative of the history and progress of printing.

— The government of Newfoundland has voted to establish a geological museum at St. Johns. Mr. James P. Howley, the geological surveyor, is now giving his whole time to it, and, before the year is over, the museum will be open to the public and to students. The collections made by Alexander Murray and James P. Howley are especially rich in orthoceratites, trilobites, and fossils of the primordial fauna.

— A cable message received at Harvard college observatory announces the discovery of an asteroid (No. 236) by Palisa, at Vienna. Its position was, April 26, 40.42 Greenwich mean time; right ascension, 13h., 0m., 43.5s.; declination south, 3° 21′ 41″; daily motion in right ascension, 44s.; in denomination, N. 6°. It is of the twelfth magnitude.

— The *Engineer* of March 29 gives a new method of preparing wood-blocks for paving, practised by Mr. Mallet of Moissac. He boils them in a solution of sulphate of copper, sulphate of zinc, and chloride of sodium, mixed with heavy mineral oil, linseed-oil, and tallow, and afterwards compresses them to about one-tenth of their original volume.

— In our last number, p. 503, Dr. Sturtevant's quotation from the *American journal of science,* which he attributes to Professor Asa Gray, is from a reprint of a portion of Dr. Carpenter's article in the *Philosophical transactions.* As Professor Gray's name does not appear in any connection, even in the introduction, and as the whole extract from Dr. Carpenter is within quotation-marks, the mistake seems unaccountable.

SCIENCE.

FRIDAY, MAY 9, 1884.

COMMENT AND CRITICISM.

THE German government has most commendably recognized the interest of the public in the reports made by the leader of the commission which has been studying the cholera in Egypt and India. The letters already so promptly published are, of course, merely notes of progress sent to the base of supplies; and no detailed and complete report can be expected at present. So far as the results have been made known, the work of the commission is full of promise. For the cholera, which, by the way, is only one of the subjects under investigation, a bacterium, apparently peculiar to the disease, has been found; and its cultivation has shown characteristics sufficiently marked to render its recognition easy. This comma-shaped bacillus has not, thus far, been found in connection with any other disease of the intestinal tract, although numerous examinations relative to this point have been made; and in cholera patients, it was only seen in association with the intestinal disturbance, but here invariably. It has, however, been met with in some sources of water-supply in India, in which the local infection may have originated.

It should not be forgotten that this work of Koch is no mere lucky guess. Bacteria were found by him in material sent to Berlin from India; but it was then impossible to decide how far putrefactive changes had produced them. The commission has now been able to examine a goodly number of fresh cases (fifty-two dead, and forty sick, from cholera), and thus to render the pathogenetic character of the bacillus exceedingly probable; and yet not a little remains to be done to complete the demonstration. Unfortunately, no inoculation experiments have thus far succeeded, owing to the remarkable insusceptibility of our household animals to cholera; and experiments on our own species are not permissible. It is also desirable to have more certainty as to the life-history of these bacilli, which may reach the victim as spores. The fact that they are chiefly found in the lower part of the small intestine suggests such a development, unless it be due to a temporary disablement of the bacillus as it passes the Scylla of gastric digestion, and the Charybdis of the bile inflow; the former being known to be dangerous, while the latter is inferentially so. Should Koch's conclusions prove to be correct (and, of course, corroboration by other and independent observers is desirable, and ought to be comparatively easy), then protection against cholera would seem to be a pretty simple task, even though its destruction at the fountain-head be impracticable. The germs do not appear to be very tenacious of life, so that an efficient prophylaxis can be readily exercised; and here a sound digestion becomes of primary importance for the individual. The season of intestinal disturbances is upon us, so that the work of the German commission can readily be supplemented in one direction in any of our hospitals.

TWELVE years ago the thorough-going policy of the British admiralty in fitting out the Challenger expedition inspired us all with a hope that a new kind of governmental policy, in support of biological investigation, was being inaugurated. American as well as English naturalists have therefore been greatly disappointed, that, since the return of the Challenger, the British government has done practically nothing to forward marine research. The economists of the Manchester school are still in the ascendant; and the study of aquatic life is evidently to be left, like the hospitals, the asylums, the life-saving service, fish-culture, and the prediction of the weather, to private enterprise, either individually exerted or in combination in societies.

It was felt by many English men of science that a portion of the surplus of the late fisheries exhibition might appropriately be applied to the scientific investigation of the English seas, since this course would undoubtedly be very beneficial to the fishery interests of the nation. The very handsome sum remaining at the disposal of the directors has gone, however, almost entirely to build homes for the families of fishermen lost at sea. In deference to the vote of the British association for the advancement of science, in support of the plea of Professor Ray Lankester, a small sum is assigned to a 'Royal fisheries society,' yet to be organized, in whose future it is difficult to imagine any great benefit to result, either to science or to the fisheries.

Public opinion in Great Britain seems to demand the organization of a series of investigations similar to those which have for a number of years been carried on by our own fish-commission. At a meeting of fishermen in Peterhead, in January, a petition was forwarded for government aid for a scientific research into the habits of fish; and the representative fishery capitalists of Ireland are equally urgent. The meeting at the Royal society's rooms, a few weeks ago, for the organization of a 'Society for the biological investigation of the British coasts,' was evidently a part of the same movement. The endowment of fifty thousand dollars, which it is proposed to secure by private subscription, will doubtless be readily forthcoming; and we may safely predict for the new society the career of success which it deserves to have. Although not a direct outcome of the fisheries exhibition, it may fairly be considered one of its results.

THE presentation of a petition, by a large number of Canadian naturalists, to the postmaster-general, requesting the government to "take into consideration the matter of a naturalists' exchange post for Canada, and for the other countries within the postal union," is a step which should meet the approval of naturalists in this country, by whom some organized attempt ought soon to be made to procure a modification of the existing regulations. As far as inland postage on specimens of natural history is concerned, no serious complaint can be urged against the postage charged, or the limit of weight allowed. The provision, however, that no written matter can be sent with the specimens, except at letter-rates, is a serious obstacle in many instances; for it frequently happens, that, as in case of marine plants mounted on paper, it is necessary to mark the locality and date on the paper at the time the specimen is collected. Without such written data, the specimens lose half their value. The rulings of the post-office department in Washington, with regard to written labels or notes giving the scientific name, locality, and date of collection, have been contradictory, and, as a matter of fact, naturalists are unable, except in an underhanded way, to send any but printed labels at the cheap rates; and, as every one knows, in by far the majority of exchanges labels must be written rather than printed. At the last meeting of the American association, a committee was appointed to consider the best way of presenting to the post-office department the claims of naturalists. It is said that the committee intend to report some plan of operation at the next meeting in Philadelphia.

With regard to foreign exchanges, of course no action can be taken without the action of the delegates of the postal union; and the Canadian naturalists desire to have the subject brought before the convention to be held in Lisbon next October. If we correctly understand the petition of the Canadian naturalists, they are now able to send packages not over eight ounces in weight, at sample merchandise rates, to countries in the postal union. If this is the case, they are much better off than we are in this country; for our post-office department has distinctly declared that no specimens of plants sent as botanical exchanges can be forwarded, except at letter-rates, no matter whether there is any writing

on the specimens or not. This is not the arbitrary ruling of any local office, but the written decision from headquarters in Washington. Such being the case, exchange of specimens with foreign countries is practically prohibited; and this seems all the more absurd, we may even say contemptible, when it is known that Christmas cards, and several other articles not classed in any way as samples, are allowed to be sent at sample-rates; furthermore, that from several foreign countries, packages of specimens are allowed to be sent to the United States at the cheap rate. Under the circumstances, it may, perhaps, be asked whether our Canadian friends are not going too far in asking that specimens not exceeding in weight four pounds, nor exceeding twenty-four inches in length by twelve inches in width or depth, be sent at the rate of one cent for four ounces. To be sure, such an arrangement seems to be eminently proper; and all naturalists should unite in bringing the measure before the Lisbon convention. In any event, the present embargo on scientific exchanges, whether caused by the illiberal interpretation of the rules of the postal union by our post-office, or by any ambiguity in the rules themselves, should be removed.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Inertia.

As Mr. E. H. Hall (*Science*, vol. iii., No. 63, p. 482) referred to Maxwell, Thomson, and Tait, as *the* authorities in regard to the use of the word 'inertia,' it seems to me it would have been well for him to explain what Maxwell meant when, in reviewing Thomson and Tait's Natural philosophy, he said, —

"Again, at p. 222, the capacity of the student is called upon to accept the following statement: —

"'Matter has an innate power of resisting external influences, so that every body, as far as it can, remains at rest, or moves uniformly in a straight line.'

"Is it a fact that 'matter' has any power, either innate or acquired, of resisting external influences? Does not every force which acts on a body always produce exactly that change in the motion of the body by which its value, as a force, is reckoned? Is a cup of tea to be accused of having an innate power of resisting the sweetening influences of sugar, because it persistently refuses to turn sweet unless the sugar is actually put into it?" (*Nature*, vol. xx. p. 214).

Did Maxwell mean by these questions to deny the statement of Thomson and Tait?

S. T. MORELAND.

Lexington, Va., April 21.

The method of measuring the inertia of a body, proposed by Mr. Hall in No. 63 of *Science*, p. 483, is identical with a mode of measuring the mass of a body. Does he consider *inertia* as identical with *mass?* If not, wherein is the distinction? Whatever be the language describing it, or the ideas concerning it, Newton says it "differs nothing from the inactivity of the mass, but in our manner of conceiving it." Here *inertia* and *mass* are, by implication at least, not identical.

W.

April 23.

The recent article by Mr. Hall on 'inertia' is especially to be deprecated, because it may lead many to regard the ideas relating to it as in some sense indefinite. The source of the whole difficulty is that the word has been used in two perfectly legitimate senses, — one qualitative, and the other quantitative. In the qualitative sense, it simply implies the truth of Newton's first law of motion: in the quantitative sense, it is mass, and nothing else. This double use of the word has been fully recognized for a generation by all accurate scientific thinkers; and, on account of this ambiguity, all careful writers and teachers have practically long since abandoned it. Above all, it ought to appear in no text-book, just because it has a double sense.

This statement as to the usage of careful teachers is directly opposed to that of Mr. Hall, who mentions Thomson and Tait, and *quotes* Maxwell in support of the position which he occupies. As no teacher is clearer in his presentation of elementary ideas, nor more precise in his choice of words for conveying them, than Maxwell, either my statement or Mr. Hall's quotation demands revision. That the latter alternative is the proper one, I shall prove by quoting the whole of the passage of which Mr. Hall quotes only a portion of one sentence: —

"In a rude age, before the invention of means for overcoming friction, the weight of bodies formed the chief obstacle to setting them in motion. It was only after some progress had been made in the art of throwing missiles, and in the use of wheel-carriages and floating vessels, that men's minds became practically impressed with the idea of mass as distinguished from weight. Accordingly, while almost all the metaphysicians who discussed the qualities of matter assigned a prominent place to weight among the primary qualities, few or none of them perceived that the sole unalterable property of matter is its *mass*. At the revival of science, this property was expressed by the phrase, 'the inertia of matter;' but while the men of science understood by this term the tendency of the body to persevere in its state of motion (or rest), and considered it a measurable quantity, those philosophers who were unacquainted with science understood inertia in its literal sense as a quality, — mere want of activity, or laziness.

"Even to this day, those who are not practically familiar with the free motion of large masses, though they all admit the truth of dynamical principles, yet feel little repugnance in accepting the theory known as Boscovich's, — that substances are composed of a system of points, which are mere centres of force, attracting or repelling each other. It is probable that many qualities of bodies might be explained on this supposition; but no arrangement of centres of force, however complicated, could account for the fact that a body requires a certain force to produce in it a certain change of motion, which fact we express by saying that the body has a certain measurable mass. No part of this mass can be due to the existence of the supposed centres of force.

"I therefore recommend to the student that he should impress his mind with the idea of mass by a few experiments, such as setting in motion a grindstone, or a well-balanced wheel, and then endeavoring to stop it; twirling a long pole, etc., till he comes to associate a set of acts and sensations with scientific doctrines of dynamics, and he will never afterwards be in any danger of loose ideas on these subjects. He should also read Faraday's essay on 'mental inertia,' which will impress him with the proper metaphorical use of the phrase to express, not laziness, but habitude" (Maxwell's Theory of heat, pp. 85, 86).

It will be observed that Maxwell, instead of calling a certain property of matter *inertia*, and defining it

quantitatively in accordance with Mr. Hall's statement, is very careful to *avoid* using the term, putting it between quotation-marks in the only place where it enters. In short, in so far as a somewhat careful inspection of the book from which the above quotation is made, of his admirable tract on Matter and motion, and of his treatise on Magnetism and electricity, warrants me, I make the assertion that Maxwell never uses the word 'inertia' in a quantitative sense. I am confident that the word does not enter into the elementary book on mechanics in any sense.

In connection with the last paragraph from Maxwell, I quote a sentence from Mr. Hall's article (the italics are mine): "Maxwell suggests certain simple experiments which the student may perform in order to become thoroughly acquainted with that property of matter which *he calls inertia*."

Mr. Hall asserts, also, that Thomson and Tait use 'inertia' in the same sense which he recommends. As Maxwell's employment of the term is so different from what we should suppose from the article in question, I had the curiosity to look into the usage of the other authors named. I find the following passage, which forms § 216 of Thomson and Tait's Natural philosophy, vol. i., part i., new edition: —

"Matter has an innate power of resisting external influences, so that every body, so far as it can, remains at rest, or moves uniformly in a straight line."

"This, the *inertia* of matter, is proportional to the quantity of matter in the body; and it follows that some *cause* is requisite to disturb a body's uniformity of motion, or to change its direction from the natural rectilinear path."

This confused definition offers a marked contrast to the clear and extended definition of mass contained in sections which precede it. It is confused, because it admits of a wholly logical but erroneous conclusion. According to the definition, if we double the quantity of matter in a body, we double the inertia of the matter present, and thus quadruple the inertia of the body. This is absurd. What is meant, but not written, is, that the inertia of a *body* is proportional to the quantity of matter in the body. Let us consider this amended form, and write I and M for inertia and quantity of matter (or mass) respectively: then the assertion is, that

$$I = MX,$$

where X is a function of any thing or every thing except mass. Now, experience shows us that I, however defined, does not depend upon time, position, temperature, electrification, or, in short, upon any change in physical condition. We must conclude, then, that

$$X = C, \text{ a constant, and}$$
$$I = C\,M.$$

The numerical value of the constant will, in any case, depend upon the system of units selected for measuring I and M: therefore we may so select the system, that C becomes equal to unity, whence

$$I = M.$$

Here we see a case where an unnecessary, and, as it seems from a casual inspection of the following portions of the work, unused term is introduced as a survival from the period of 'the revival of science.' Of course, the passage does no harm to those who are competent to read the work which contains it: nevertheless, Maxwell would not have used it.

It is worth noting, that Mr. Hall, in the last paragraph of his article, finally gives a definition of mass as a quantitative definition of inertia. Of course, this is the only quantitative notion which can be attached to it.

A passage in the article under discussion reads, "Text-books too frequently say, in such a connection, that 'masses of matter receive motion gradually, and surrender it gradually,' or that 'it requires time to impart motion to a body as a whole,' — statements from which the student is in danger of getting the idea, if indeed he gets any idea, that the *time* is required in order to draw things taut within the body, and get its particles to acting upon each other, somewhat as it takes time and a succession of jerks to take up the slack of a freight-train while it is being started." Unlike its writer, I should recommend the sentences within quotation-marks to the special attention of the student, and emphasize the fact that *time* is required to transmit motion from one part of a body to another by the statement, that, in physics, this time is known as the measure of the velocity of propagation of a wave of disturbance. Finally, if I used the illustration of the freight-train (not a bad one in its way), I should be careful to explain to the student that the jerks are due only to the fact that the train is not mechanically homogeneous.

Obviously, the discussion of the term 'inertia' is not of the slightest scientific importance at this stage of scientific development; but it is of enormous pedagogical importance that loose ideas should not be taught. I have been prompted to the above remarks by appeals from some, who, supposing they had definite notions of elementary mechanics, had been led into confusion by Mr. Hall's statements.

C. S. Hastings.

Baltimore, April 24.

In *Science*, No. 63, Mr. E. H. Hall makes an attempt to clear away the mistiness which he seems to have discovered in the use of the word 'inertia.' No word in the English language deserves more sympathy than this. It has been knocked about so constantly that it must long ago have given up all idea of being able to 'persevere in a state of rest.' Lately there have been many indications of an intention to put it on the retired list in the near future, and for the present to assign it to such duties as it may be capable of performing without injury to itself or others. But Mr. Hall inconsiderately orders it to the front, and insists on endowing it with a real vitality, which, in the opinion of the writer, renders it capable of doing a good deal of harm.

Much of the confusion in the use of the word 'inertia' has originated in the various interpretations of Newton's first law. It is indeed curious to see how many different versions of this celebrated statement may be found in a half-hour's search.

Thomson and Tait, the restorers of Newton, say, 'Every body *continues* in a state of rest,' etc. To this form of statement it is difficult to object in any way. It is a simple statement of a fact, the denial of which "is in contradiction to the only systems of doctrine about space and time which the human mind has been able to form" (Clerk Maxwell). This version of the first law is identical with that of Tait in his Recent advances.

But another translator uses the word 'perseveres' instead of 'continues,' — the rendering so wisely chosen by Thomson and Tait; for 'to persevere' means, by common consent, something more than 'to continue.' Webster says, 'To persevere is to continue, *in spite of discouragements*,' etc. In an excellent and modern treatise on physics, the law is written, 'Every body tends to persevere,' etc., in which, evidently, 'persevere' is used in the generic sense of 'continue,' but in the ordinary sense, to 'tend to

persevere,' is not wholly satisfactory. In one edition of the Principia which lies before me, I find the statement that 'every body . . . endeavors to persevere in its present state,' etc. Here, certainly, we begin to see some trace of Mr. Hall's 'inertia;' and I should not be surprised to meet with the statement, in full harmony with his views, that 'every body tries to endeavor to persevere,' etc.

The beginner in physics is certainly liable to be confused in his endeavor to grasp this idea, — the idea of the mysterious resistance which Mr. Hall illustrates in his string-pulling; but his confusion will be vastly increased when he comes to grapple with the proposition, that "we must distinguish very carefully between inertia itself, a property of matter, and the resistance which matter can exert in virtue of that property," comparing it, as Mr. Hall does, with that property in virtue of which a man can exert force, and the force which he may be actually exerting at any time; and particularly when he is told that the resistance which he has considered is not the body's inertia, but is *merely the manifestation of that property!*

The unquestionable tendency of all this is to cause the student to attribute to the word 'inertia' some occult meaning. Most teachers of physics have encountered this condition of things, and have found some trouble in ridding their pupils of it.

Now, a brief analysis of Mr. Hall's own statements will unveil the mystery. If he had tied his string to the ghost of a fifty-pound ball, the resistance offered would have been nothing; at least, we may so affirm, in the present state of our knowledge in regard to ghosts. But the string was tied to a *mass*, and when he pulled it, he learned, that, in order to do work, work must be done. In short, the word 'inertia,' when properly used, is synonymous with 'mass;' and it is so used by nearly if not quite all the first authorities. There is, therefore, nothing mysterious about it, and, I may add, scarcely any reason for its use at all.

Mr. Hall mentions Maxwell, and Thomson and Tait, as apparently sustaining him in his view of the matter, quoting to a limited extent from the first.

Thomson and Tait, in their Natural philosophy, although not affirming that matter 'endeavors to persevere,' etc., do say that "matter has an innate power of resisting external influences, so that every body, as far as it can, remains at rest, or moves uniformly in a straight line." And this innate power is called 'the inertia of matter.' It is declared to be proportional to the quantity of matter in the body, and is afterward used as synonymous with mass.

This assertion of the existence of an 'innate power' bears the stamp of high authority, and one ought to question it with fear and trembling. But there is no evidence, that I have been able to find, that its authors believed in it themselves; that is, in the sense in which many people undoubtedly understand it. I have always regarded it as an unfortunate expression, which was likely to leave an impression which was never intended.

Professor Rankine, who was not careless in the use of terms, uses 'inertia' as meaning 'mass.'

Maxwell is universally admitted to have been a man of rare insight into the nature of things; and, as he is quoted by Mr. Hall, it may be interesting to see, as far as may be, what his position was on the point in question. His earliest public expression of opinion, as far as I know, was in his paper, 'On the properties of matter,' prepared at the age of seventeen years for Sir William Hamilton. This concludes as follows: "and the impossibility of a body changing its state of motion or rest without external force is called inertia." The next, as far as I know, is found in the Theory of heat, quoted by Mr. Hall. But in beginning the quotation where he does, Mr. Hall, unintentionally no doubt, does Maxwell an injustice. The sentence preceding that quoted is a most important and necessary part of the whole statement [quoted in full by C. S. Hastings, above].

It will be observed that this gives a perfectly definite meaning to the phrase 'measurable quantity,' and one quite different from that which might be inferred from Mr. Hall's fragmentary quotation.

Later came that remarkable 'little book on a great subject,' the Matter and motion; and it is a curious fact, and worthy of note, that the word 'inertia' does not occur in this book, not even in its compound form of 'moment of inertia.' It can hardly be believed that this omission was any other than intentional. His opinion of the 'innate power' may be learned from his review of Thomson and Tait's Natural philosophy [same quotation as given in first letter, above].

T. C. MENDENHALL.

In his article (*Science*, April 18), Dr. Hall writes as follows: "Elementary text-books usually speak of inertia as a mere *inability*, — the inability of a body to set itself in motion, or to stop itself when in motion. This is an old use of the term, but certainly not the best use."

Right here, I am constrained to believe, is Dr. Hall's fundamental error or misconception. He mistakes inertia for mass, and, strangely enough, laboring under this illusion, makes Maxwell use the word 'inertia' where in the text will be found the word 'mass.' For example: Dr. Hall goes on to say that "Maxwell suggests certain simple experiments which the student may perform in order to become acquainted with that property of matter which he calls inertia." Now, by reference to the article referred to, the reader will find Maxwell's words to be exactly as follows: "I therefore recommend to the student, that he should impress his mind with the idea of mass by a few experiments, such as setting in motion a grindstone, or a well-balanced wheel, and then endeavoring to stop it," etc.

Dr. Hall says, "We are driven to the conclusion that matter possesses a property in virtue of which it *offers resistance* to an agency which is setting it in motion." If Maxwell regarded inertia as an entity, 'a measurable quantity,' is it not remarkable that he did not even once, so far as I am able to find, use it in his incomparable work on Matter and motion?

If, as Dr. Hall is forced to conclude, "matter possesses a property in virtue of which it offers resistance," *why does it not resist?* Has a mass of matter, free to move, ever been known to 'stand still'? Certainly not: the whole science of dynamics will be overturned when such an instance occurs. The illustration given by Dr. Hall verifies *our* position. The fact that his heavy weight 'is left slightly swinging,' shows that a large mass will *not* resist the slightest force. Of course, the velocity generated will depend on the time of application. The whole thing is contained in the equation, $v = \frac{ft}{m}$. If m is large, and f small, t must be large to make v considerable. Thus, in the case cited, there is an attempt to make v considerable in a short time (t): therefore f must be large; and it is easily made larger than the string can bear, when, of course, it breaks.

In his second illustration, in which 'a weak thread'

is 'pulled gently and steadily,' is the reason that the fifty-pound weight acquires a greater velocity, because the weight resists less (if so, then resistance is less than itself), or because the time of application is greater?

In elementary works on physics, the word 'inertia' should be seldom used, lest the pupil acquire the impression that inertia is an entity. Most exact writers, foremost among whom is J. Clerk Maxwell, carefully avoid the use of the word. But if Dr. Hall's quasi-definition, given in the last paragraph of the article under discussion, is to be accepted, then must the word necessarily become one of constant use. It is a pity that Maxwell has not given us a definition of 'an inertia unit.' We shall be pleased to have Dr. Hall supply the desideratum. A. P. GAGE.

In my article on 'Inertia' I was mainly concerned for the distinct recognition of a physical fact. My interest in the word 'inertia' was secondary. Professor Mendenhall and Mr. Gage appear to deny the reality of the 'resistance' of which I spoke in defining inertia. I said, "Matter possesses a property in virtue of which it offers resistance to an agency which *is setting* it in motion." Professor Mendenhall attempts to avoid the idea of a resistance in explaining the fact that force is required to set a body in motion, by speaking of the *work* done. The attempt seems to me entirely unsuccessful, unless he has some unusual definition of the word 'work.' According to Maxwell (Theory of heat, 4th ed., p. 87), 'work is done when resistance is overcome;' and, though he does not say that work is done *only* when resistance is overcome, no reader of Maxwell will deny that he meant that. This, by the way, is the only reply I need make to my critics' use of Maxwell's tea-and-sugar illustration; for certainly Maxwell considered setting a mass in motion to be doing work. With this I leave the question of physical fact, and come to that of the word or words used to denote that property which I have called 'inertia.'

In using the word 'inertia' as I did, I knew perfectly well that I assigned to it a meaning sometimes given to the word 'mass.' I knew that Maxwell, in the very passage of which I quoted a part, and of which Dr. Hastings has quoted the whole, used 'mass' as I have used 'inertia.' It was my belief, however, and it still is, that Maxwell, in that famous chapter, used 'mass' in two senses. He does use it as I have used 'inertia,' and in that case defines it as a '*property* of matter' (the italics are mine). Elsewhere in the same chapter he says, "What is really invariable is the *quantity of matter* in the body, or what is called in scientific language the *mass* of the body," etc. (the italics are mine).

As to Maxwell's use of the word 'inertia,' I was in error. I certainly spoke as if he gave undoubted sanction to the word in the sense in which I have used it. This I had no right to do, for he merely states what others have meant by this word. Any one, by reading the passage which Dr. Hastings has quoted from Maxwell, will see all the excuse I have to offer for my blunder.

Dr. Hastings admits that Thomson and Tait use the word 'inertia' to denote that property of matter for which I have used the same name; but he says that their statement is confused. This criticism is just; but it is irrelevant, unless Dr. Hastings means to imply that Thomson and Tait wrote 'inertia' where, in a clearer moment, they would have written 'mass.' Moreover, his commendation of their definition of the latter word might lead one to infer that Thomson and Tait use 'mass' as Maxwell does in the passage he has quoted. What, then, is their definition of 'mass'? It reads thus: '*The quantity of matter* in a body, or, as we now call it, the *mass* of a body," etc. (art. 208).

And now what is the practice of my critics in the use of the words 'inertia' and 'mass'? In the preface of Mr. Gage's Elements of physics, we read, "Dr. C. S. Hastings of Johns Hopkins university has read the larger portion in manuscript, and the remainder in proof-sheets." On p. 8 of this book I find, "By the *mass of a body* we understand *the quantity of matter in it*," and on p. 20, "The term *mass* is equivalent to the expression *quantity of matter*." Of course, the word 'mass' occurs in many other passages of the book; but I have discovered no case in which it appears to denote any thing but *quantity of matter*.

As to the use of 'inertia' in the same book, on p. 90 I find, "This inability is called *inertia*. Evidently the term ought never to be employed to denote a hindrance to motion or rest." But when we come to the subject of centrifugal force, p. 101, we read, "Centrifugal force has, in reality, no existence: the results that are commonly attributed to it are due entirely to the tendency of moving bodies to move in straight lines in consequence of their inertia."

Now, one of these results is the maintenance of the solar system. Why do not the planets, obeying the law of gravitation, fall into the sun? According to the teachings of this book, we must answer, "Simply because of their 'utter inability' to put themselves in motion, or to stop themselves, although this inability must never be understood as a 'hindrance to motion or rest.'" A little farther on in the book we read, it is true, that "to produce circular motion, the centripetal force must be increased . . . as the mass increases." 'Mass' enters here when the book speaks of numerical relations; but we see, that, when it attempts to *explain* 'centripetal force,' it appeals to 'inertia,' and says nothing whatever of 'mass.'

I think it not too much to claim that 'mass,' used to denote that property of matter which Thomson and Tait call 'inertia,' is comparatively rare, while one can hardly take up a book upon physics without finding 'mass' used in the sense of 'quantity of matter.' That an exceedingly intimate relation exists between inertia as I have defined it, and mass as commonly defined, I am well aware. Thomson and Tait's words are, "This, the *inertia* of matter, is proportional to the quantity of matter in the body." I should prefer to say, bodies of equal inertia (see the last paragraph of my article on 'Inertia') are assumed to contain equal quantities of matter. Quantity of matter, in this sense, is called 'mass.'

If it seems best to use 'mass' to denote also the property of matter which Maxwell undoubtedly does denote by it, let us so use it; and, by all means, let its double meaning be distinctly recognized in the elementary text-books. To me it seems far wiser, however, to use the two words, 'inertia' and 'mass,' substantially as Thomson and Tait use them, and to rigorously exclude from the text-books the comparatively useless 'inability' definition of inertia.

E. H. HALL.

Silk-culture in the colonies.

The term 'silk-balls' was doubtless employed at times to designate cocoons; but that is quite different from 'raw-silk' and 'raw-silk balls,' which, as we stated, might more appropriately apply to the twisted hanks of raw silk which are so doubled and

tied as to suggest such a designation. The choking or drying of the cocoons was in colonial days a part of silk-raising, and not of silk-reeling; and, while reeling-establishments may undertake to choke the cocoons brought in by the raisers in their immediate neighborhood or by agents, the marketing of fresh cocoons must necessarily be limited in time and distance. They cannot bear pressure without injury, and all baled cocoons must needs be choked. One is hardly justified in comparing the methods of colonial times with those in vogue to-day in France, where modern steam filatures and railroads have produced such profound modifications. We cannot see how choked cocoons, which have but one-third to one-fourth the weight of fresh cocoons, can be marketed at the same rates as the fresh cocoons. The term 'green' cocoons is often used in English as the equivalent of fresh cocoons; but, as quoted in the French markets of to-day, the word 'green' (*vert*) refers to those of a green or greenish color. Perhaps this may explain the puzzle. C. V. RILEY.

Thermometer exposure.

In No. 58 of *Science*, Professor Mendenhall calls attention to interesting differences of the minima temperatures on cold, still nights of the winter. I agree with him that a difference of exposure, and proximity to buildings, may explain a difference in reading; but it is impossible to explain by them alone the enormous difference noticed in Columbus (27.3° F.). There must have been, besides, one or another of the following conditions, probably both. When the conditions are favorable to radiation, and the night is still, the lowest strata of the air are mostly cooled by contact with the cold, upper surface of the ground; and more so if there is snow, and a so-called inversion of temperature is produced. The temperature rises from the lowest strata to a certain height. Examples of this can be found in the observations at Pulkova, near St. Petersburg. A thermometer placed at the height of seventy-eight feet was almost constantly higher than one at six feet above ground at eight P.M. In August, on clear days, the mean difference was 2.1° F., and once in September it was 5.2° F. In the months from December to March, when the ground is covered with snow, even at one P.M. the upper thermometer was higher than the lower; the mean difference on clear days of December and January at one P.M. amounting to 1.3° F., and once it amounted to 4.1° F.

The same results were obtained by experiments made at Kew, by direction of the meteorological office. The minima were lower at a height of twenty-one feet above ground than at a hundred and twenty feet; and on one occasion, at nine P.M., during a fog, the latter was higher by 10.8° F. than the former.

Now, most of the signal-service stations must have comparatively high minima, not only because they are mostly located in the interior of cities, but because the thermometers are often placed very high above the ground, at the level of the fifth or sixth story of city buildings. Probably the stations of the Ohio state service are placed lower.

Besides the height of thermometers above the ground, what I call the 'topographical conditions' are of importance. At an equal distance from the level of the ground, under conditions favorable to radiation, there will be much lower minima in valleys than on hills. This is caused by the descent of the coldest and heaviest air to the valley, and also by the fact that in a valley the air is in the vicinity of a greater surface of the ground. During the anticyclone of Dec. 19-30, 1879, the summit of Mont Verdun, near Lyons, France, had a mean temperature of —1.7° C.; and the Parc de la Tête d'Or, in the city, situated four hundred and fifty metres lower, a mean of —7.1° C. The mean minima differed by more than 12°C. Very likely the observations of the state service at Columbus were made on lower ground than those of the signal-service. Where anticyclones in winter are common in high latitudes, with the ground covered with snow, the mean temperatures of the winter months must be considerably colder in valleys than on the surrounding hills and mountain slopes, as the insolation during the day interferes but slightly, and not at all during some days at points beyond the polar circles, with the equilibrium of air strata obtained during the night.

This cold of the nights in valleys, subjecting plants to freezing on nights when those that grow on hills are spared, is well known. Perhaps it is less noticed in the United States, as there low temperatures are oftener accompanied by high winds than in Europe. The olive-cultivators in southern France, and the coffee-growers in the hilly districts of the province of San Paulo, southern Brazil, know this so well that they do not plant their trees in valleys, from fear of frosts. A. WOEIKOF.

St. Petersburg.

Dalmanites in the lower carboniferous rocks.

During a recent geological excursion near this city, one of our party, Mr. Henry Lane, found and pointed out to me a trilobite, which I extracted from the stone myself. The rock on which we were working was the upper part of the Cuyahoga shale of the Waverly group of Ohio, now universally, I believe, referred to the lower carboniferous system. The only genus hitherto reported from these rocks in America is Phillipsia, with the exception of two species of Proetus scarcely distinguishable from Phillipsia. The specimen in question, however, distinctly differs from both of these in the pygidium, the only part yet obtained. Instead of the evenly rounded and margined tail of those genera, it shows the flabellate and fimbriate form of Dalmanites. The occurrence of this genus or of this type of trilobite, so high in the geological series, is both surprising and 'uncanonical.'

E. W. CLAYPOLE.

Buchtel college, Akron, O.,
April 14.

'A curious optical phenomenon.'

Except in one curious point, 'F. J. S.'s' latest experiment (*Science*, No. 63, p. 475) obviously accords with my note (same page). Apparently, the virtual image is three feet *in front* of him, or nine feet from the wires, since the phantom rises when he bows; the slats are seventeen and two-thirds times wider apart than the wires, from centre to centre; and every fourth wire hides every third slat, while the next wire but one hides a slat-shadow. But how can thirty slats and their shadows thus give *twelve* dark phantom lines? With his telescope, 'F. J. S.' may find that two of them, least perfect, are where wires cross the *frame* of the blind.

Two words of mine, three lines from the bottom of the page, require correction. The size of the image is not 'very nearly' as described, but *exactly* so. If this image could become an actual screen, then *its* image, in turn, would be the farther screen; and any line through a wire-crossing in either of the three screens would meet the other two at points *quasi*-homologous to each other.

JAMES EDWARD OLIVER.

Cornell university, April 29.

A half-starved pig.

The following fact, though not unexampled, yet seems to me worth record. In the first week of September, 1883, on the farm of Mr. William Burr, in Medina county, O., the steam-thresher was at work; and, as usual, a large stack of straw was gradually accumulated. Two or three days afterwards Mr. Burr missed a fat sow weighing about three hundred pounds. After a long search and much inquiry, he came to the conclusion that she was lost in some unknown manner, and thought no more of her. About the 20th of March, 1884, in pulling down the remains of the straw-stack, the sow was found, thin as a deal board, but living. Her weight was a hundred and sixty pounds. She had been imprisoned for two hundred and five days, without water, and with only the straw for food. Treated with judgment, and fed slightly at first, she did well, and is now growing fat again. E. W. CLAYPOLE.

Buchtel college, Akron, O.

THE SCIENTIFIC METHOD IN HISTORICAL STUDY.

THE phrase 'science of history' suggests two very different things to different minds. To one kind of persons it means philosophical reflection and combination upon the course of human action in masses, in the purpose of finally discovering the laws by which such action has been governed, and then of applying these laws to prophesy about the future of the race. To these persons, Buckle is the ideal of a scientific historian. He alone, they fancy, has grasped the true principle of historic research, and truly shown the parallelism between the historical and the scientific methods. Just as the naturalist discovers his facts, and then combines them into laws, so the historian shall, it is said, proceed from single phenomena of human effort to the discovery of laws according to which all such human action has moved, and therefore must and will move. On the whole, perhaps, this is the view of historical science which prevails in the minds of most educated persons in America.

But there is another idea suggested by these words to those who have been accustomed to the thought and language of another school. These persons maintain that such effort is not historical work at all, but quite another science, dealing with the *results* of history. It is philosophy, with its general hypotheses and their more or less effectual support in discovered fact. All this should be called, not history, but the philosophy of history, just as there might be a philosophy of literature or of music, pursued successfully, perhaps with the best success, by men wholly untrained in either literature or music. Buckle and his kind, this school asserts, were not historians, but philosophers; and it claims for itself the more modest title. This we may, for convenience, call the modern German school, though it has its followers now widely spread in other lands. Not that Germans of our century have not cared to concern themselves with the wider problems of man's social and political destiny (nowhere, perhaps, have these problems received more thought than just in Germany), but this has remained the province of philosophers; and the men who have raised Germany to the leadership in modern historical research have, on the whole, kept themselves free from all speculation of the sort. To this school, then, the 'science of history' means the pursuit of historical knowledge according to scientific *method*. It concerns itself wholly with extracting from existing material the truth of the record. But to do this, it demands previously the most rigid examination and criticism of the material. For this examination, a wide and deep training in language, and in a general knowledge of the accepted historical tradition, is necessary; so that, while this German school is content to restrict itself within seemingly narrow limits, the man who would conform to all its demands finds a life-work before him, broad and severe enough to call forth all his intellectual energy. Its motto is found in the modest word of the elder Droysen, that the object of historical study is '*forschend zu verstehen*' ('to comprehend while investigating').

The study of history in America is in its infancy. It has remained until now an object of almost complete neglect in the programmes of collegiate as well as of secondary study. This neglect must have had a cause: we have no desire to force an issue between the two schools of historical study; but the fact cannot be overlooked, that, as long as American education remained under the influence of the early English tradition, history, as an item in education, was practically left out of sight. Men had, or professed, an enormous respect for it. One can read orations and lectures by the score, upon the usefulness of history as an element in the life of the present; but when it came to putting this usefulness into play, as a part of a scheme of education, giving to history a fair opportunity by the side of Greek, Latin, and mathematics, history had to give way. Men showed their respect for it by letting it alone. On the other hand, no sooner did the wave of German influence begin, about a dozen years ago, to beat with a violence that could not be disregarded, upon our shores, than the fortunes of historical teaching were

completely changed. Young men, returning from their study abroad, brought home with them this new principle, — to learn while, and by, investigating. All at once a new analogy to the study of nature began to be emphasized. The historian was to accompany the naturalist in his method of taking the thing to be studied in his hand, and applying the microscope to it; but this was to be done no longer with the ultimate purpose of deducing general laws of human progress, but simply of completing the record. Under this new impulse, history has now fairly begun to take its place by the side of other studies, as a subject demanding, in the widest sense of that term, a scientific treatment.

It would be a misfortune if either of the schools we have been examining should gain permanent and complete control over the other. Each has its claim to respect; but, for a long time to come, it seems clear that that view of the subject which has brought about so important, so decisive a change must remain the one to which our science must look for its support and its vindication.

These comments upon the condition of American instruction have been suggested by the appearance of two books, each in its way important for the future of the subject. 'Methods of teaching and studying history,' edited as the first volume of a proposed 'Pedagogical library,' by Dr. G. Stanley Hall, consists of an essay, occupying about half the volume, by Dr. G. Diesterweg, well known in Germany as the author of numerous pedagogical works, and of shorter contributions by professors in leading American colleges, together with an excellent short bibliography of general history by Prof. W. F. Allen of the University of Wisconsin. The importance of this book at the present time lies far more in its general purpose, and in its suggestion of a strong force behind it, than in any special excellence of its own. The treatise by Diesterweg is subject to the criticism, so often deserved by German writing, that it succeeds in obscuring the subject it tries to explain. The translation maintains all the obscurity of the original, and adds much of its own. The essays by American teachers were prepared, on what seems a wholly false principle, without any common understanding as to division of the field, and bear somewhat of the perfunctory character incident to most writing done at the demand of an editor. The various writers repeat each other; and the effect can hardly be to impress strongly upon the minds of teachers in the lower schools any effectual lessons for their own guidance. It is to be regretted that the German essay could not have been left out altogether, and replaced by something based upon a wider range of thought, and more pertinent to our American problem. If the American writers could have known each what the other was writing, the result would have been more harmonious, and the effect, as a whole, more decided. Yet one advantage has come from this defect: it has demonstrated how strong is the current which is now setting in the direction of what we may call, by a phrase which will cover many varieties of detail, 'teaching by topics.' There is complete agreement, among the writers, on this point, — that effectual teaching in history, as everywhere else, is that which rouses the student out of the dulness of a merely receptive condition, and puts him into the attitude of an original thinker. There would be a multitude of opinions as to the age at which this sort of work should begin, the exact form it should take, its proportion to the work of the memory, and so on. It is to be hoped that an opportunity will be offered for the further development of these points, — far more valuable for the teacher than a philosophical treatise in the cumbrous form of German metaphysical treatment.

Another point emphasized by some of the writers, and tacitly admitted by others, is the necessity for a steady progress of the student in the acquisition of a firm basis for his knowledge in space and time: chronology and geography, learned by a definite act of memory, according to one or another principle, must begin and accompany all study of history. This demand has called forth the second of the books referred to, — Ploetz's 'Auszug aus der geschichte,' translated and enlarged by Mr. William H. Tillinghast of the Harvard college library. This book was originally made for the use of students while engaged in detailed study, to furnish them with a substantial basis of general knowledge. It holds a middle position between a mere dictionary of dates and a connected narrative of general history. The work of translation has been done with something better than accuracy, — with a complete command of the original language, and a conscientious purpose to improve upon the material offered. The new volume is essentially a book for Americans. It will be welcomed by persons holding all shades of opinion as to historical methods, and ought to become a permanent factor in the new development through which the teaching of history is passing.

WINTERING IN THE ARCTIC.

A SHIP may winter in the ice under somewhat varied circumstances. She may be drifting in the pack during this time, unable to make a harbor, as in the cases of the Terror, Tegetthoff, Jeannette, Fox, and others (this may happen under two conditions, that is, whether liberated or not from the pack; these cases have been already noticed); or the ship may be frozen in, in the hummocky pack, but not subject to drift, as in the case of the Erebus and Terror, off King William's Land; or she may be safely ensconced in some good sheltered haven. In the first case, the most dangerous of all, it is seldom that any thing can be done but await events. A northward drift is a most perilous circumstance; and, although in the case of the Tegetthoff the crew managed to escape unscathed, it was only by a miraculous combination of favorable events. The disaster to the Jeannette and her unfortunate crew shows better what may usually be expected. It is this fact, to a great extent, that has led so many arctic expeditions to follow that continuity of shoreland which is swept by southward-trending currents, in preference to all others. Many arctic sailors of experience have even strongly contended that it is a matter to be at once considered, when a ship is thus probably circumstanced, if she should not be immediately abandoned before the northing gained would seriously compromise all hopes of escape. In a winter's drift it is impossible to properly 'bank' a vessel, as the incasing with snow-walls is generally termed, and it is consequently a severe labor to keep an equable temperature in the unprotected ship. In the case of the unfortunate Tegetthoff, "while in the berth close by the stove there was a temperature ranging between 100° F. and 131° F., in the other there was one which would have sufficed for the north pole itself. In the former a hippopotamus would have felt himself quite comfortable; and Orel, the unhappy occupant of it, was often compelled to rush on deck, when the ice-pressures alarmed us, experiencing, in passing from his berth to the deck, a difference of temperature amounting to 189° F." (Payer). The story of the Jeannette and the Terror also shows the miseries of unbanked vessels. In vessels properly 'banked,' however, no such variations of temperature need be encountered, even in the severest weather. The illustration (fig. 1) showing the Germania wintering in the ice is given to show an improperly 'banked' vessel, although well housed. Sketches (if they be accurate) of by far the greater majority of exploring-ships wintering in the ice show the same (and generally greater) lack of proper arrangements for keeping out the cold. A good contrasting picture is the one given (fig. 2) of the whalers wintering at Marble Island, in North Hudson's Bay; they being experienced icemen, and aided by Eskimo in the snow-construction. The sketch was taken by Mr. Klutschak of my party, while in the bay during the winter of 1878–79. I visited these ships that winter for a short while, and lived in one the next winter for no inconsiderable time; and, although the temperature outside was about the usual mean of arctic wintering-harbors, that inside was comfortable in all parts of the ships. To contrast with Payer's statement above, I would say, that, while the cabin showed about 80° or 85° F., the captain's room, separated from it by a door with lattice shutter, would seldom be over five or ten degrees lower; while in the 'houses' built over the ships it was generally a little below freezing, and very comfortable for persons who spent a proper time out of doors for exercise. This 'banking' is most conveniently done by Eskimo, when their services can be secured, as their superior ingenuity in snow-construction enables them to enclose the vessel in even several concentric snow-houses, thus securing the most equable temperature with

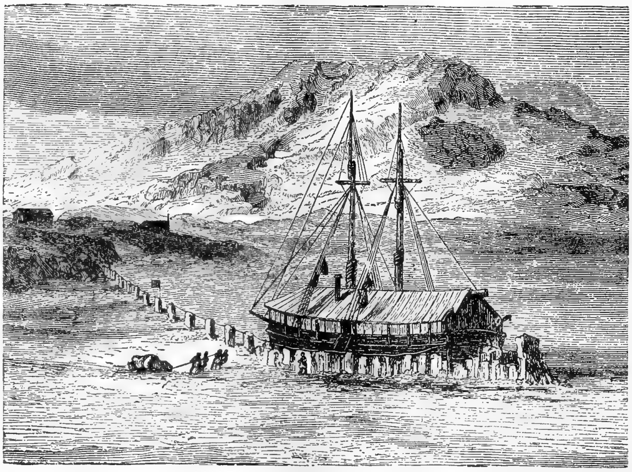


FIG. 1.—THE GERMANIA WINTERING IN THE ICE.

the least amount of material, which is quite a consideration when this monstrous mass has to be removed in the spring.

The drifting winter-beset ship has one advantage worth noting. If drifting towards warmer waters, as is generally the case in following the usual routes, she is almost certain of a safe and speedy release in the early spring months; and the constant state of alarm experienced by all ships' crews while in these involuntary journeys from ice-pressures, and threatenings of a general destruction of the ice-fields, has almost its compensation in the necessarily banished *ennui* and lonesomeness in by the crew by short rambles and hunts is lost.

A vessel safely anchored in a good harbor is, of course, in the most favored condition of all. She may unbend her sails, lower her yards and topmasts, presenting a minimum of surface to the heavy arctic gales of that season of the year, while she is awaiting her freezing in, and which is especially necessary when the character of the bottom of the harbor is such that there is danger of dragging the anchors. Once frozen in securely, the anchor can be raised, the rudder cut out and unshipped, and all these, with masts, and yards, and spare stores, and

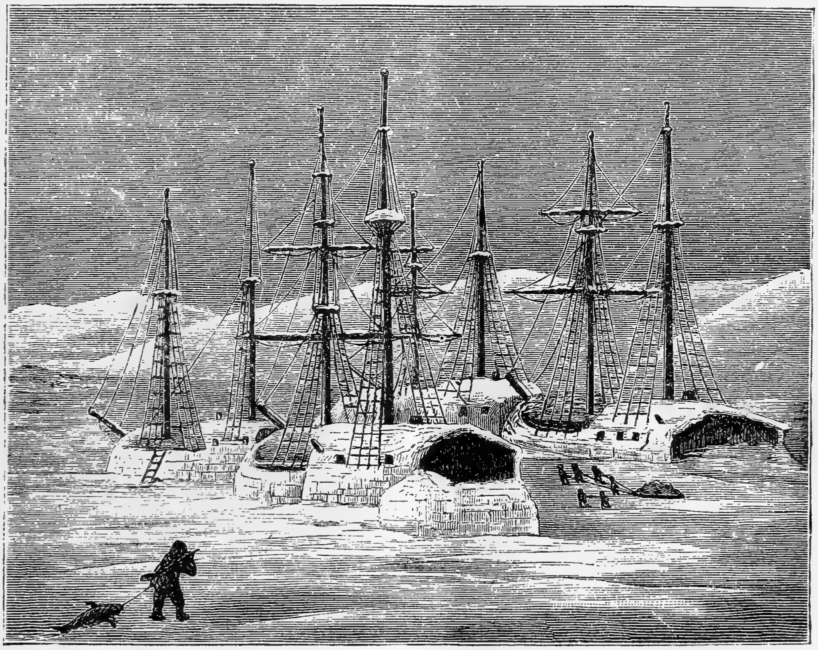


Fig. 2.—Whalers at Marble Island.

of the long polar night, with its accompanying evils of idleness and disease. Forced activity to overcome lonesomeness soon wearies, loses its effect, and becomes really a punishment, while that prompted by danger never loses its stimulating effect.

A vessel wintering in the ice, unable to secure a harbor, but not subject to drift, may be liable to much danger when the fields break up in the following summer; and this danger will generally be greater the farther she is from land, owing to her earlier liberation, probably long before the navigable season commences. In a vessel far from land much of the benefit derived from the voluntary exercise indulged provisions, may be placed on the shore conveniently by, and then room be made for the winter's entertainments, exercises, and studies. The very first thing a ship should do, after selecting her winter harbor, is to get ample provisions ashore, to be prepared for the loss of the ship by wreck or fire. This is always done by the whalers. A vessel is then 'housed in,' which is done by building a shed over the deck with lumber brought for that purpose. This house is generally about seven feet high, the lumber covered with canvas, this with a layer of moss or turf six inches to a foot thick, cut in the early fall before it has frozen, and dried as much as possible, and this layer of

turf again covered with from three to four feet of snow, which should be continuous with the snow-walls or snow-heaps placed along the sides of the ship. I give (fig. 3) my idea of a ship fixed for winter, shown in cross-section.

The 'house' is of inclined boards, covered

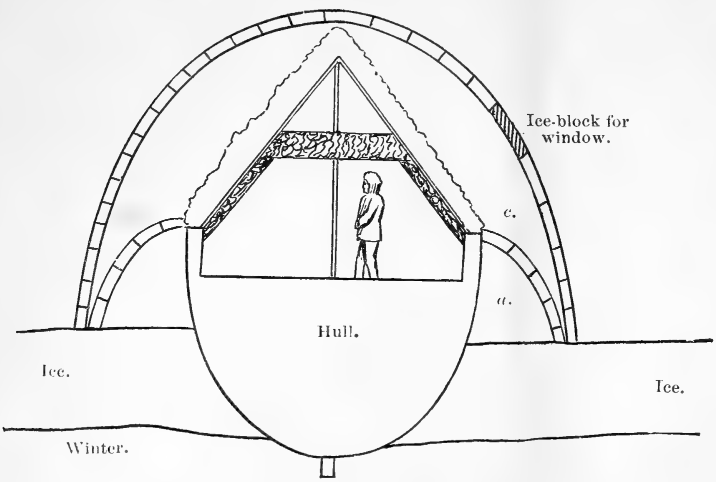


Fig. 3.—Section of wintering ship.

with canvas, and again covered with dry turf. Inside it is lined with cheap canvas holding six or eight inches of 'mineral wool,' or other light cheap non-conductor; and this passes over just above the heads of the occupants. The snow-huts are shown by their cross-section of block-work, the inner air-space, *a*, being hermetically sealed, as far as it is possible with snow to do so. The second air-space, *c*, should be left open on warm days, that is, above − 10° F. to − 20°. The house should run the whole length of the vessel, but be divided into two rooms for officers and men, and with only one door leading out, and that from the men's room. The stove in the cabin should have its draught flush with the level of the floor, and its stove-pipe within another of three or four inches more radius, and a propeller-blade ventilator run by clock-work in the latter to 'suck' air into the cabin. This will be the main source of ventilation, warming the air as it enters, and also protecting the ship from possible fire from the chimney. The draught will remove all foul air from the cabin-floor, and the companion-way will purify the lighter gases at the ceiling. Such a stovepipe as shown will obviate the great collection of frozen moisture around it, the descending cold air preventing the escaping warmth from melting contiguous snow and ice. The clock-work should be susceptible of regulation according to will, and run for at least twelve hours. At its exit from the outer dome of snow, the larger pipe should stop short of the smaller or inner, and be protected by a roof springing out from it, as shown in fig. 6. Light is secured by large thick blocks of ice placed in the sides of this 'house' at convenient intervals. If an 'igloo' dome be thrown over the vessel according to the proposed plan, the slabs of ice in it should directly face the double glass windows in the house proper.

If turf or canvas is not employed in the usual methods, the temperature of the house must be kept below freezing, or the continual melting of the snow, forming pools of ice on the ship's deck, will be disagreeable in the extreme. A housing solely of canvas, as has often been employed, prohibits the use of a thick layer of non-conducting snow or turf, and,

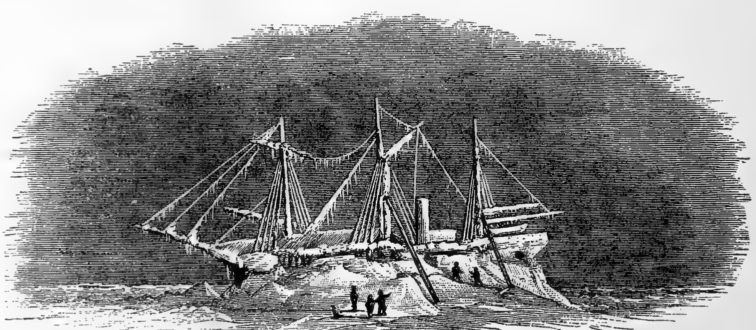


Fig. 4.—Tegetthoff wintering.

except during a wind, it is but little better than no protection at all. The housing should extend the whole length of the ship if possible; but if cut short at the middle portion, a not unusual method to save lumber, the exposed deck should be treated to a covering of snow and turf similar to that placed on the house. Where moss or turf is not to be had, fine sand

is not a bad substitute, but is much heavier, and can only be used on horizontal or slightly inclined surfaces.

The importance of securing a winter harbor near where Eskimo can visit the ships is not

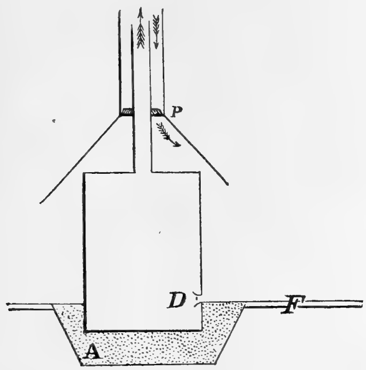


FIG. 5.

to be over-estimated. Besides their aid in snow-construction, the clothing procured from them is far superior to any that can be manufactured in civilization for withstanding the severe temperatures of those regions; their companionship does much to alleviate the lonesomeness of the winter's solitude, for they are generally a most cheerful, merry-hearted, and contented race; their services in procuring game from both land and water, to keep the crew in a healthy state, and especially to combat the scurvy, is apparent; while, in case of disaster, their humble abodes are always open to the shipwrecked sailor until there can be convenient times for

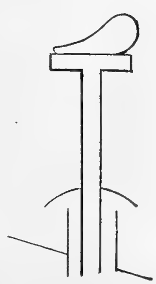


FIG. 6.

by, which must be opened every morning and evening, and a snow-house (igloo) thrown over it (if natives are at hand to do the work) to protect it from drifting snow, our ship is ready to pass her arctic winter unmolested, until the coming summer opens a renewal of her labors.

Should the circumstances warrant a start early in the season, it will probably be necessary to cut a very long channel through from six to ten feet of ice, of sufficient dimensions to float the ship to the outer open water. The methods of cutting these channels vary. I show the one I have seen adopted, given in plan (fig. 7). The channel *B B B B* is always brought up *alongside* the ship, as shown; since, should she draw more water than the thickness of the ice, and the channel be brought up immediately behind her, the outgoing tide or a strong wind might break her loose, and sweep her out before it was intended she should move. The scarf-lines *c c*, *c c*, *c c*, formed in sawing, are sufficiently intelligible to be understood without an explanation; the ice-blocks, *A*, *A*, *A*, being allowed to float out along with the ebbing tide, a single person directing each one as fast as sawed off with a pike pole, to prevent its horizontal rotation, and consequent binding in the channel. Where the channel is long, and wind favorable, rough impromptu sails have been rigged on each ice-block to carry it out. If cutting very thin ice, as when cutting into harbor in the fall, these slabs can be shoved under the edge of the ice-channel. If the vessel delays her starting until after the solar rays have made considerable impression on the ice of the harbor, it will save much labor to remove the snow along the contemplated scarf-lines of the channel, and place there a covering of black seaweed, sand, dirt, or ashes, which will have cut deeply into the ice by the time the sawing is necessary. These layers, of course, should be very thin: other-

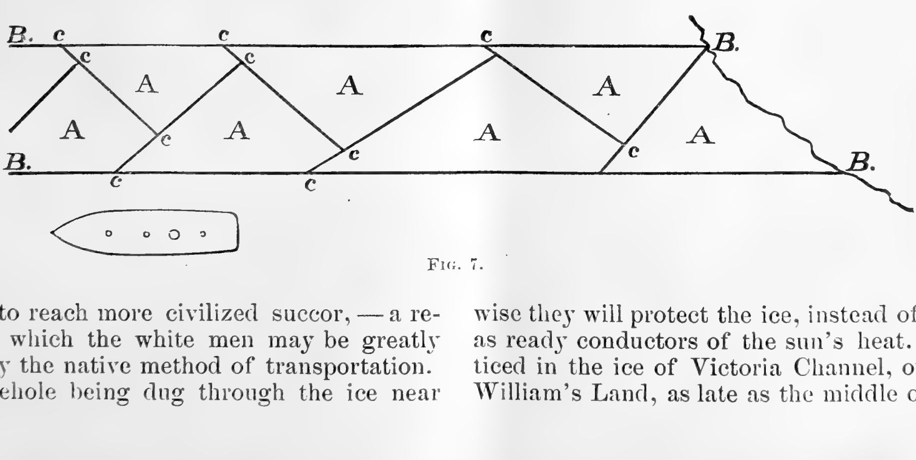


FIG. 7.

retreat to reach more civilized succor, — a retreat in which the white men may be greatly aided by the native method of transportation.

A firehole being dug through the ice near

wise they will protect the ice, instead of acting as ready conductors of the sun's heat. I noticed in the ice of Victoria Channel, off King William's Land, as late as the middle of July,

that a dark-colored kelp-stalk over twenty feet long had cut five feet into the solid ice a crevice not over an inch or two wider than the stalk, so that it was impossible to get it out.

The difficulty of sawing increases in a rapid ratio with the thickness of the floe; and, when its depth becomes so great as to allow a play of but a foot or two with the ice-saws, it becomes essentially impossible. Ice-saws, if very thick, impose severe labor on those operating them, by their great weight: if thin, they will warp and cramp in the thick ice, also creating severe labor. As all these contingencies cannot be foreseen, it is desirable to have a considerable assortment of these utensils, varying in length and weight. I think a description, however short, of ice-saws, is hardly needed, but will briefly speak of the ways I have seen them used. A 'one-man saw,' like the same named article in timber-sawing, can be used in ice up to four feet. Another foot, or even to work effectually in from three to four, requires two men, as shown in fig. 8; and it is evident, that, as the labor increases, the force at the bar can be increased, if the saw is only strong enough. As the floe gets thicker, the saw must be larger and have greater play, to work effectively; and this soon gets beyond the power of men and the reach in their arms, and a tackling is rigged, as shown in fig. 9, which can, I think, be understood without explanation. If the weight of the saw is not sufficient to pull it down, with the pushing assistance of the two men, its submerged end must be loaded with an anchor or anvil.

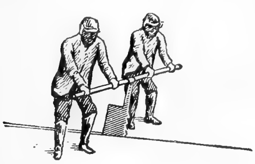


FIG. 8.

A small funnel-shaped harbor, with but few projections along its converging sides, may sometimes be relieved of all its ice at one time by a small amount of sawing along these serrated edges, and a happy combination of tide, wind, and good management. This is especially the case where the rise and fall of the tide exceeds the thickness of the ice, the consequent vertical oscillation of the ice keeping it broken up in hummocky masses along the shore-line.

The use of blasting-apparatus has, so far, been of but little use; still I think a series of small charges, fired electrically, giving rather a pushing than a splintering concussive effect, might be used advantageously in removing quite large masses of obstructing ice favorably situated. Blasting, I believe, would also be more efficacious in harbors not fed by fresh-water streams, as here the ice is more brittle, less tenacious and elastic, and consequently harder to remove by the percussive power of explosives.

A sailing-vessel can wait almost until she is liberated by the forces of nature, as this will probably be the earliest date that she can use her peculiar motive power effectively.

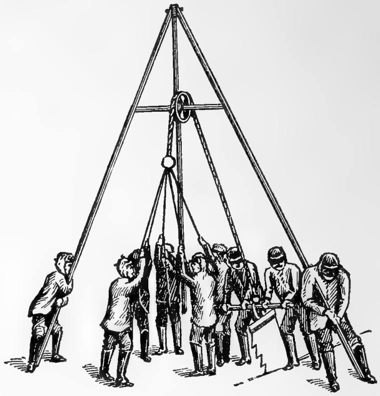


FIG. 9.

Even a good harbor may have its disadvantages for a ship, if she has entered it during an exceptionally open season; and, unless this recurs within the time for which she is provisioned, she must be abandoned to save the lives of the crew. McClure's Investigator in the Bay of Mercy, in 1854, is an example of such necessary abandonment.

The use of balloons to make slight ascents, — they being made fast to the ship, — to enable the ice-master to obtain a more comprehensive view of the state of the ice, has never yet been experimented with, though by many recommended, and consequently can be neither rejected nor accepted as an auxiliary in this sort of cruising. Certain it is, however, that nothing is more deceitful at times than ice-packs or ice-drifts at a distance; the most invulnerable-looking, upon a closer examination, proving to be the most disjointed, and the reverse. No arctic ship, of course, will be without her 'crow's-nest' of the whalers, — an elevated 'lookout' on the foremast, with good protection from inclement weather, for her ice-master.

The advantage in having two ships over one is apparent. It proved the salvation of Parry on his third journey, and other instances are not wanting. The benefit of two crews to cut in or out of harbor, and in other work where it is the same for one as a dozen vessels, is not to be overlooked.

In general, near the magnetic pole, the ship's compass is more or less worthless, its sluggish oscillations being easily overcome by the most insignificant local attraction, which it is almost impossible to avoid on shipboard. The farther removed from this great centre of magnetic force, necessarily the more reliance can be placed on the needle. The simple plan of rudely determining the points of the compass by a watch or chronometer regulated to mean time, conjoined with the motion of the sun in azimuth, will be sufficient in a land where the sun is shining throughout the day, and especially when the navigation depends rather on the bearings of the 'leads' and ice-barriers than any determinate direction. The fact that a vessel should follow a continuity of land, if possible, lessens the importance of the compass while capes and headlands can be kept in view.

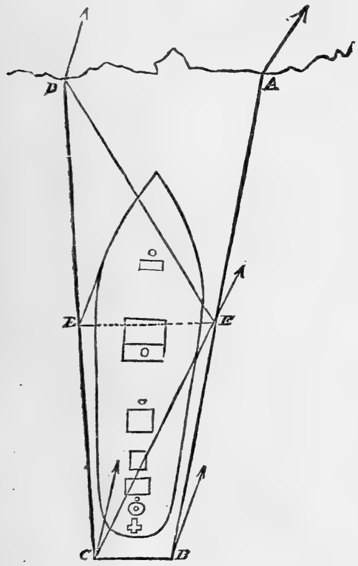


Fig. 10.

The 'ice-blink' is a well-known yellow glare that seems to hang over pack-ice. Any channels of natural sky seen through the glare indicate open water under them; and this is of use in approaching ice. In fact, the 'ice-blink' is more marked when at a distance from a pack in open water than when in one pack viewing another at the same distance.

Having explained ice-sawing, and hinted at a 'dock,' I will briefly describe an artificial one, and take as a typical example the case of the Alert, docked in the ice, Aug. 12, 1875, in Smith Sound. A plan of the dock is given in fig. 10. It was cut in about four hours, and could have been done, says the commander, in half the time, with a better organization and more experienced ice-cutting crew. It is a necessary operation to prevent being crushed between two bodies of ice, when the time will allow it, and also when a natural dock, formed of irregular blocks or floes, is liable to be obliterated by the increasing pressure eroding the fragile edges of the blocks. In this latter case a dock cut into the solid side of the largest block or floe would probably be a safe haven. The use of steam has rendered docks much less necessary than formerly, as the time occupied in cutting one will allow almost any steamer to escape any average danger.

Although, from this rather long list of probable arctic accidents to which a ship is exposed, escape would seem rare, yet, after all, it is wonderful to notice the small number of craft actually lost in this dangerous species of navigation, in proportion to the whole number engaged. Only those that are lost under tragic circumstances being brought before the public, they are generally supposed to be the greater majority of those thus employed.

Fred'k Schwatka,
Lieut. U. S. army.

BESTOWAL OF THE GRAND HONORARY WALKER PRIZE ON PROFESSOR JAMES HALL.

Some years ago Dr. William J. Walker gave to the Boston society of natural history a prize-fund, from which, in accordance with the terms of the gift, annual awards are made to successful competitors who have written essays on assigned questions. But, besides these annual awards, a grand honorary prize was provided for, to be given every five years, and which the society was to grant, on recommendation of a special committee, "for such investigation or discovery as may seem to deserve it, provided such investigation or discovery shall have been made known or published in the United States at least one year previous to the time of award."

The society, in previous years, has awarded this honorary prize, amounting to five hundred or a thousand dollars, at the option of the society, to Mr. Alexander Agassiz and to Professor Joseph Leidy. This year the committee, after due consideration of the subject, has unanimously concluded to recommend for this prize, Professor James Hall of Albany; and the award of the highest sum was accordingly made by the society, at its meeting of May 7.

As the founder would appear to have contemplated some particular or integral 'investigation or discovery,' "we need not," says the committee, "take into account Professor Hall's numerous works or publications upon North-American geology and paleontology for the last forty years and more (comprised in about twenty-six volumes or parts of volumes, and in over two hundred articles or papers, reports, etc.), except as they relate to a special line of investigation, which Professor Hall early made his own, in which he has long been eminent, and which he may be said to have essentially completed, although a considerable portion of the results, which have been from

time to time 'made known' to the scientific world, are not yet published *in extenso*, with the illustrations prepared for the purpose.

"It is, then, specifically for Professor Hall's investigations in North-American paleontology, notably the paleontology of the state of New York and the regions adjacent, and of the earlier geological formations, that the committee suggests this award. In this field Professor Hall holds a position like that which has been so long occupied in Europe by Mr. Barrande. If his actual publications are as yet less extensive than those which have made the name of Barrande illustrious, this has not been from the lack of material, still less from lack of industry and scientific acumen on Professor Hall's part, but because he has not enjoyed the advantages of independent fortune and munificent patronage. Giving due credit to the state of New York for what it has done to further the publication of researches in its service, it still appears that his prolonged labors have been carried on under many discouragements and with insufficient means. It is understood, however, that deficiencies in this respect are about to be remedied; and it is hoped that this veteran paleontologist may have the satisfaction of superintending the full publication and proper illustration of his completed investigations.

PORTRAIT OF PROFESSOR JAMES HALL OF ALBANY.[1]

"In recognition of the great value of the scientific work to which Professor Hall's life has been so untiringly and successfully devoted, in encouragement of his closing labors, and in testimony of the society's high appreciation of these services to science, your committee would recommend that the maximum of the prize be awarded upon this occasion."

[1] From a crayon drawing, after a photograph taken for *Science*, April 17, 1884, by T. W. Smillie, photographer of the U. S. national museum.

THE CANTILEVER-BRIDGE AT NIAGARA FALLS.

THE new bridge across the Niagara River, built to connect the Canada southern railway with the New-York central and Hudson-River railroad, and opened for traffic in the early part of the present year, has been widely noticed in the newspapers, and referred to as a marked advance in engineering. Quite a general interest in regard to it has therefore been aroused by the apparent novelty of the design, and the rapidity of construction. As the railway suspension-bridge is below, and within some three hundred feet of, the cantilever-bridge, the contrast between them is forced upon every observer. While the cost of the two bridges, aside from the approaches, was probably very nearly the same, the suspension-bridge required three years for its construction, and will carry one train and such load as may come upon the lower roadway; the cantilever-bridge was erected in seven months and a half from the beginning of the work, and is designed to carry a freight-train on each of its two tracks at the same time, each headed by two seventy-six ton engines, and crossing without slackening speed. The ability to accommodate a greater traffic, and the rapidity of construction, may justly be ascribed to the advances made in American types of iron bridges.

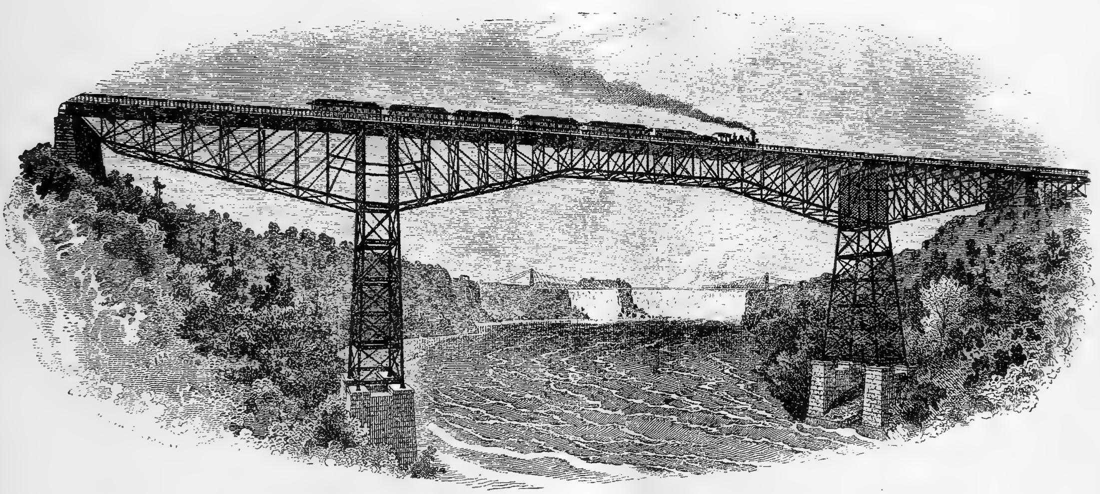
One of the first questions asked concerns the meaning of the term 'cantilever.' It signifies, as an architectural term, 'a bracket, or projecting member, to support a load, such as a cornice or balcony.' The illustration accompanying this article gives a very good view of the structure as a whole; and the action of the cantilevers, as well as the several members, can be understood from the following diagram.

The shore abutments are at A and F, nine hundred and ten feet apart. The piers B and E, having a width on top of twenty-five feet, support two trusses,

$A\ C$ and $D\ F$, the lengths of whose arms are marked below them: on their outer ends rests the independent truss $C\ D$, one hundred and twenty feet in length. The parts $B\ C$ and $D\ E$ are the cantilevers, carrying the truss $C\ D$, and projecting from the piers B and E as a bracket from the face of the wall. The ends A and F are prevented from rising, under any load between B and E which may not be balanced by the excess of weight in $A\ B$ and $E\ F$, by anchoring bolts at A and F, extending to iron beams placed beneath the shore abutments. These abutments weigh one thousand tons each: the maximum lifting-force to which either one will be subjected is three hundred and forty tons. The expansion and contraction from changes of temperature are provided for between B and E by joints at C and D which allow longitudinal motion, and at A and F by pendulum links which permit a similar movement.

A detailed statement of the rate of progress in construction and erection will show quite clearly the advance made in late years in the art of bridge-building, and the ease with which structures of the American type, jointed at intersections and connected by pins, can be put together. The contract for the bridge was signed on April 11, 1883; and a clause was included by which the builders would forfeit five hundred dollars per day for all time required to finish the structure after Dec. 1. Ground was broken for the foundations of the towers, April 15. Laying of the concrete foundation, eight feet thick, began on June 6; and of the masonry piers, thirty-eight feet high and twelve feet square on top, June 26. The masonry on the American side was finished Aug. 20, and on the Canadian side Sept. 3. The two towers or steel piers, each of which has four legs, sixty feet by thirty feet apart at the base, twenty-eight feet by twenty-five feet apart at the top, one hundred and thirty-two feet high from the top of the masonry to the bottom of the truss, and thoroughly braced in all directions, were begun Aug. 29, and completed Sept. 18.

Scaffolding or false-works for the support of the portions $A\ B$ and $E\ F$ having been put up, these shore-arms were built upon it in the usual manner of bridge-erection, and were finished in time to begin construction of the river-arms on Nov. 1. This portion of the bridge was built out, piece by piece, triangle by triangle, from the piers, with no other outside support than a travelling framework above and projecting forward from the bridge itself: this traveller carried a suspended platform to insure the safety of the workmen. The sections from the two shores were built out and joined Nov. 21, without serious accident or delay. The track was down, ready for a train, in seven months and a half from the beginning of the work, and with eight days to spare on the contract time.



THE CANTILEVER-BRIDGE OVER THE NIAGARA RIVER.

The bridge has two trusses, twenty-eight feet apart, fifty-six feet deep over the towers, twenty-one feet deep at the shore-ends, and twenty-six feet deep at the mid-span. Ample wind-bracing is provided. The material used in the towers and heavy compression members is open-hearth steel: most of the other members are of wrought-iron. One admirable point in the design of the engineer, Mr. C. C. Schneider, and in the way in which it was executed by the builders, the Central bridge-works of Buffalo, N.Y., was the fact that no piece, while the bridge was in process of erection, was subjected to a strain greater than, or different from, what it must undergo in the completed structure. At the formal test and open-

ing, Dec. 20, the bridge was traversed by two trains, advancing side by side from one end, and composed of twenty locomotives, and enough cars loaded with gravel to together cover both tracks completely. The independent span *C D* was occupied entirely by engines when the bridge was fully loaded. The deflection of the point *C* under the test was between six and seven inches, being an aggregate arising from the yielding of *A B*, the compression of the tower, and the deflection of *B C* itself. On the removal of this load, of double the amount which will probably ever be imposed upon the structure, the bridge completely recovered itself.

The application of the cantilever in bridge-building may be seen in several other instances in this country. Sometimes it has been used to diminish the opening to be spanned by a single truss, and more frequently it has been introduced to facilitate the erection of a bridge in places where temporary supports in mid-channel could be obtained only with great difficulty and expense. A wagon-bridge at Fort Snelling, Minn., furnishes an example of the former class; but the cantilevers are reduced to simple triangular brackets, projecting some thirty or thirty-five feet beyond the faces of two adjacent piers, and reducing the span to two hundred feet. The Cincinnati southern railway bridge, over the Kentucky River, has three spans of three hundred and seventy-five feet each. As the gorge which this structure crosses is two hundred and seventy-five feet deep, and ordinary false-works were out of the question, the spans were built out from each cliff as projecting trusses, anchored back to the rock. By the aid of one temporary timber tower on each side, and the iron piers, the bridge was thus joined in the middle. The lower chord connections were then severed at three hundred feet from each bank, leaving the middle span with a cantilever of seventy-five feet projecting from each of its ends. Here the introduction of hinges obviated the changes of strain which would otherwise be caused by the effect on the tall iron piers of changes of temperature. The Minnehaha bridge, across the Mississippi River, between St. Paul and Minneapolis, has three spans, and was erected like the Niagara bridge, — the two shore-arms on false-works, and the middle span as two cantilevers, which are connected by a hinged joint in mid-river, without any independent span.

A design for the Frazer-River bridge on the Canadian Pacific railway, by Mr. Schneider, although not yet erected, antedates the Niagara bridge, and is like it, only on a smaller scale. The design for the Blackwell's Island bridge, across the East River, New York, which was awarded the first prize in 1876, introduced cantilevers and an independent span. A similar type of bridge is in progress at St. John, N.B.; one is proposed for the new Harlem-River bridge, New York; and the great bridge for crossing the Frith of Forth, now under construction, is a bold design of this type, having two openings of seventeen hundred feet each. Others might be mentioned if space permitted.

CHAS. E. GREENE.

THE CHOLERA BACILLUS.[1]

THE question, which, in my last report of Jan. 7, was left unanswered, — whether the bacilli found in the intestines affected with cholera are parasites due to cholera alone, — may be looked upon as answered.

It was at first exceedingly difficult, on account of the varying conditions under which the pathological changes took place in intestines affected by cholera, and on account of the great number of bacteria constantly present in them, to find out the bacillus proper to the disease. In most cases death occurred, not at the height of the cholera process, but during the period of reaction immediately following, in which such important changes take place in the condition of the intestines and their contents, that it is impossible, from such cases alone, to gain a clear conception of the cholera process. Only when one has had an opportunity to dissect a number of uncomplicated cases, and to compare with them the conditions exhibited in persons when first attacked, is it possible to gain a correct insight into the pathological conditions of cholera. On this account it was always kept in view, to use the greatest caution in accepting any theory as to the connection of the bacterial condition and the cholera, or as to causal connection of the bacteria with cholera, till the full proof might be obtained.

In the last report, I could already state that the peculiarities of the cholera bacteria were so well determined that they could safely be distinguished from others. Of these characteristics, the following are the most striking: the bacilli are not perfectly straight, like other bacilli, but slightly curved, like a comma. The bending may go so far that they take the form of a half-circle. In the pure cultivation from these bent rods often arise s-formed figures, and more or less long, slightly wavy lines, of which the first are made up of two, and the last of a large number, of the cholera bacilli, which, by continued increase, have remained connected. They possess powers of locomotion, which can best be seen, and in most marked degree, in a drop of cultivation-liquid suspended on a cover-glass: in such a preparation, one sees the bacilli moving with the greatest velocity in all directions through the field.

Especially characteristic is their action when cultivated in gelatine, in which they form colorless colonies, which at first are closed, and appear as if they consisted of very brilliant little glass particles. Gradually these colonies liquefy the gelatine, and spread out to a considerable extent. In gelatine cultivation they are, therefore, through this remarkable appearance, very surely distinguished from other bacteria colonies, and can easily be isolated from them. Moreover, they can pretty surely be distinguished by cultivation in hollow slides, as they always go to the edge of the drop, and in that position can be recognized by their peculiar movements,

[1] Sixth report of Dr. KOCH of the German cholera commission, dated Calcutta, Feb. 2, 1884. Translated from the *Berliner klinische wochenschrift* for March 31. An abstract of the seventh report will be found in the Notes and news.

and, after application of aniline solution, by their comma form.

As yet, twenty-two cholera bodies and seventeen cholera patients have been subjects of investigation. All these cases were studied for the presence of the specific bacteria, as well with gelatine cultivation as also in microscopical preparations, for the most part through cultivation in hollow slides; and, without exception, the comma-shaped bacilli were found. This result, together with that obtained in Egypt, justifies the statement that this kind of bacterium is always to be found in the cholera intestine.

For corroboration, moreover, investigations were carried on in the same way on twenty-eight other bodies (of which eleven had died from dysentery); the evacuations of one case each of simple diarrhoea, dysentery, and of a convalescent from cholera; then from several well people, as well as on animals dead from ulcer in the intestine, and pneumonia; finally, also with putrid masses of impure water (various samples from city sewage, water from very impure swamps, swamp scum, and impure river-water): but in not a single instance did it happen, either in stomach or bowels of the bodies of man or beast, in evacuations, or in fluids rich in bacteria, that the cholera bacteria was found. As by arsenic-poisoning a sickness very similar to cholera can be induced, an animal was killed by arsenic, and, after death, the digestive organs examined for the comma bacillus; but with a negative result.

From these results the further conclusion may be drawn, that the comma bacillus is peculiar to cholera.

As to the connection of this bacillus with cholera, it was carefully stated in the last report, that there may be two views: 1°, that the condition of the organs of a person sick with cholera is such that this peculiar bacillus prospers; 2°, that the bacillus is the cause of the cholera, and that only when it makes its way into the bowels of man can the sickness take place. The first supposition is not allowable from the following grounds: it would be necessary to grant, that, when a man is taken sick with the cholera, this bacillus was already present in his organs, as shown by its universal presence in the considerable cases investigated in Egypt and India, two widely separated lands. This could not be the case, however; since, as has already been pointed out, the comma-shaped bacillus is never found, except in a case of cholera.

Even in cases of bowel affection, such as dysentery and bowel catarrh, to which cholera very often supervenes, they fail. It is also to be considered, that, if this bacterium were always present in man, it would surely have been observed on some occasion; which has not been the case.

As the increase of this bacterium cannot be brought about in the bowels by cholera, the second supposition, that it is the cause of cholera, only remains. That this is, in fact, the case, is shown unquestionably by other facts, and especially by its behavior during the progress of the disease. Its presence is restricted to the organ in which the disease is, — the bowels. In vomit, they have, as yet, only been noticed in two cases; and in both, the appearance and alkaline reaction of the vomited fluids showed that the contents of the bowels, and with these the bacteria, had got into the stomach. In the bowels their history is as follows: in the first evacuations of the patient after the attack, as long as they have any form, very few cholera bacilli are present; the watery, odorless evacuations which follow, on the contrary, contain the bacilli in great numbers; while, at the same time, all other forms disappear almost entirely, so that, at this stage, the cholera bacilli are cultivated practically alone in the bowels. So soon as the cholera attack lessens, and the evacuations are again fecal, the comma bacteria disappear gradually, and are, after the convalescence, no longer to be found. The same is found to hold in cholera subjects. In the stomach no cholera bacilli were found. The bowels varied, according as death had occurred during the cholera attack or after it. In the freshest cases, the bowels showed a clear, red color; the inner lining of the intestines was still free from submucous extravasation; and the contents consisted of a colorless, odorless liquid: the cholera bacilli were present in enormous masses, and nearly pure. Their distribution corresponded exactly with the degree and spread of the inflammation of the lining-membrane, the bacilli being generally not so thick in the upper intestine, but increasing toward the lower end of the smaller intestine. When, however, death has taken place later, the intestines show signs of an important reaction. The lining is dark red in the lower part of the smaller intestine, impregnated with extravasations of blood, and often dead on the outermost layers. The contents of the bowels are, in such cases, more or less blood-colored, and, in consequence of the re-appearance of the bacteria of decomposition, putrid and fetid. The cholera bacteria at this stage begin to disappear, but continue still to be present for some time in the solitary glands and in their vicinity, — a circumstance which first called attention to the presence of this peculiar bacterium in the bowels of the Egyptian cholera subjects. They entirely fail in such cases, only when the patient has lived through the cholera, and dies from the after-weakness.

The cholera bacteria act exactly as other pathological bacteria. They occur only in their peculiar disease; their first appearance is when the illness begins; they increase in number with the severity of the attack, and gradually disappear as the illness wanes. They are found where the trouble exists; and their number, at the height of the disease, is so great, that their injurious effect on the lining of the intestines is explained.

It might well be wished that it were possible, with these bacteria, to engender in animals a disease akin to cholera, that their causal relation to the sickness might be made the more clear. This has, as yet, not been done: whether it will ever be done may well be questioned, as animals do not appear to be subject to cholera infection. If any kind of animal could take the cholera, then such a case would have been observed in Bengal, where, during the whole year, and

over the whole country, cholera infection is spread. But all reported cases have, as yet, failed of corroboration. Nevertheless, the evidence of the facts produced cannot be weakened by the failure of the experiments on animals. With other infectious diseases, the same observation has been made; for example, in the case of typhoid fever and leprosy, — two diseases for which specific bacteria are known, without, as yet, its being possible to communicate them to animals; and yet the manner of the occurrence of the bacteria in these diseases is such, that, without doubt, they must be looked upon as the cause of the disease. The same holds true for the cholera bacteria. Moreover, the further study of the cholera bacteria has made known many of their peculiarities, which all agree with that which is known of cholera etiology, as well as further evidence of the correctness of the assumption of the bacteria as the cause of the disease.

In this connection it is well to state the often observed fact, that in the linen of cholera patients the bacteria increase in a most remarkable manner, when the clothes have been soiled with the evacuations, and then, for twenty-four hours, have been kept in a moist condition. This explains the known fact, that the people having to do with such affected linen are often attacked. On account of this, further experiments were instituted; and cholera evacuations, or the contents of the intestines of the dead, were spread on cotton, on paper, and especially on the damp surface of the ground. After twenty-four hours, the thin sheet of slime invariably changed into a thick mass of cholera bacilli.

Another peculiarity of the cholera bacteria is, that they die, upon drying, much more quickly than most others. Commonly all life is extinct after three hours' drying.

It has also been noticed that their development only takes place well in substances having an alkaline reaction. A very small amount of free acid, which would have little or no effect on other bacteria, puts a marked check on their growth.

In a healthy stomach they are destroyed, which is shown by the fact that neither in the stomach nor the intestines of animals which had been constantly fed on cholera bacilli, and then killed, were any found. This last peculiarity, together with the impossibility of their withstanding drying, gives an explanation of the every-day observation, that infection so seldom occurs from constant intercourse with cholera patients. Evidently, that the bacilli may be in condition to pass the stomach, and bring about the cholera in the intestines, peculiar conditions must be present. Perhaps, when the digestion is imperfect, the bacilli might be able to pass the stomach; and the fact observed in all cholera epidemics and in India, that those suffering from indigestion are especially subject to cholera, may bear out this view. Perhaps a peculiar condition, analogous to the period of inaction of other bacteria, would enable them to pass the stomach uninjured.

It is, on the whole, not probable that this change in the production of inactive spores exists: then such spores, by observation, are known to remain months, or even years, capable of life, while the cholera poison remains active not longer than from three to four weeks. Nevertheless, it is conceivable that some other form of inactivity exists, in which the bacilli can retain their life in a dry state some weeks, and in which they withstand the destroying influence of the stomach.

The conversion into such a condition would correspond with that which Pettenkofer has designated as ripening of the 'cholera-infection material.' As yet, such an inactivity of cholera bacilli has not been discovered.

THE EXPLORING VOYAGE OF THE CHALLENGER.

(*First notice.*)

THE Challenger was a British man-of-war, a corvette of twenty-three hundred tons, equipped at the public expense with every appliance for the scientific study of the sea and of marine life, and carrying a faculty of six civilian specialists chosen by the Royal society, in addition to a staff of naval officers selected with reference to their scientific attainments.

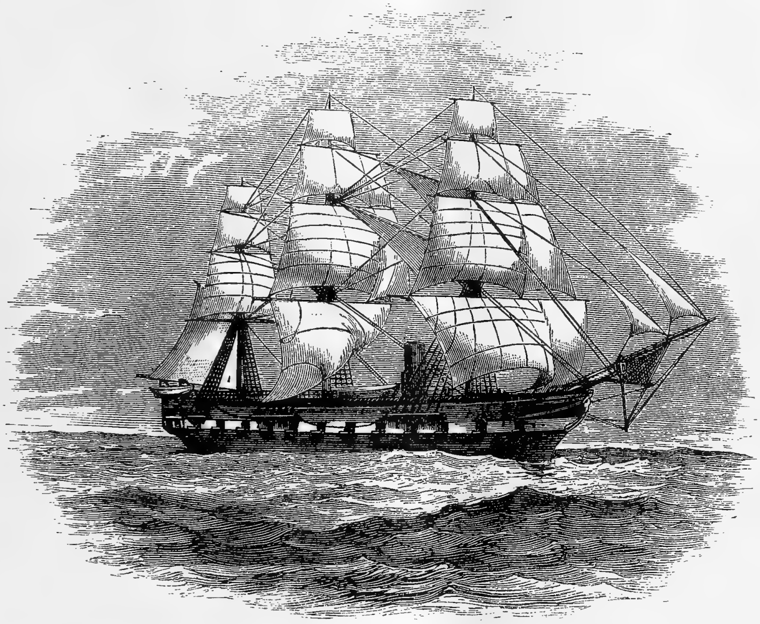
This floating laboratory was sent out in 1872 upon a voyage of discovery around the world, and, during an absence of three years and a half, visited every accessible sea and ocean, traversing a distance of nearly sixty-nine thousand miles. Three hundred and sixty-two observing-stations were established at sea, and over five hundred deep-sea soundings made, — a wonderful record of industry, when it is remembered how many weeks were necessarily spent at coaling-stations, and when we take into account the fact that the present methods of rapid work by means of thin-wire dredge-ropes had not then come into use, and that a dredge-haul from a depth of two thousand to twenty-five hundred fathoms, which the Blake or the Albatross now easily completes in four or five hours, took an entire day of the Challenger's time.

The collections, when finally assembled at Sheerness, after the return of the ship, were contained in 2,270 jars, 1,749 bottles, 1,860 glass tubes, and 176 tin cases of alcoholics, with 22 casks of specimens in brine, and 180 tin cases of dried specimens, besides large quantities of material already sent home from Bermuda, Halifax, Capetown, Sydney, Hong Kong, and Japan.

The Challenger long ago resumed her barbaric function as an engine of war. Her trawls and dredges, battered and torn, hang upon the stair-rails in the Museum of naval architecture in South Kensington. Their share in the work

is done, but the collections are only now beginning to yield up the treasures of fact which they contain. The first of the final reports appeared in 1880; and now ten massive quarto volumes, crowded with sumptuous lithographed plates, have been printed, eight of these in the natural history series, two in the 'narrative,' which includes also the results of the physical observations. The completion of the entire series is promised for 1887, but it can safely be predicted that the last of the row of twenty volumes will not be placed upon our bookshelves before 1890. Preliminary reports have appeared to the number of at least three hundred; and, since it has been decided that the biological section of the British association is to devote its attention at the Montreal meeting almost exclusively to pelagic life, we may expect a large addition to the Challenger bibliography during the present year.

The Challenger expedition was planned and executed solely in the interest of pure science, no utilitarian aims having ever been considered in its organization: it was the direct outgrowth of the previous expeditions of the Lightning and the Porcupine, inspired and conducted by Carpenter, Gwyn Jeffreys, and Wyville Thomson. The action of the British admiralty had, in consequence, a particularly salutary effect upon the policy of other nations; for it is highly probable, that, had there been no Challenger, the subsequent important explorations by Norway, Sweden, and Germany, and the expeditions of the Italian Washington and Violante, the French Travailleur and Talisman, the Dutch Willem Barents, and the American Blake, Fish Hawk, and Albatross, would not all have been carried on by grants from public treasuries. What the several governments might have done in fitting out ships, it is impossible for us to know. No one can question, however, that naturalists in all countries have been inspired and stimulated in a most salutary way by the action of the British government in publishing every half-year one of these sumptuously printed Challenger volumes, — each a collection of monographs from the hands of master-workmen in natural history, not English only, but American, Scandinavian, Dutch, French, and Italian.



THE CHALLENGER.

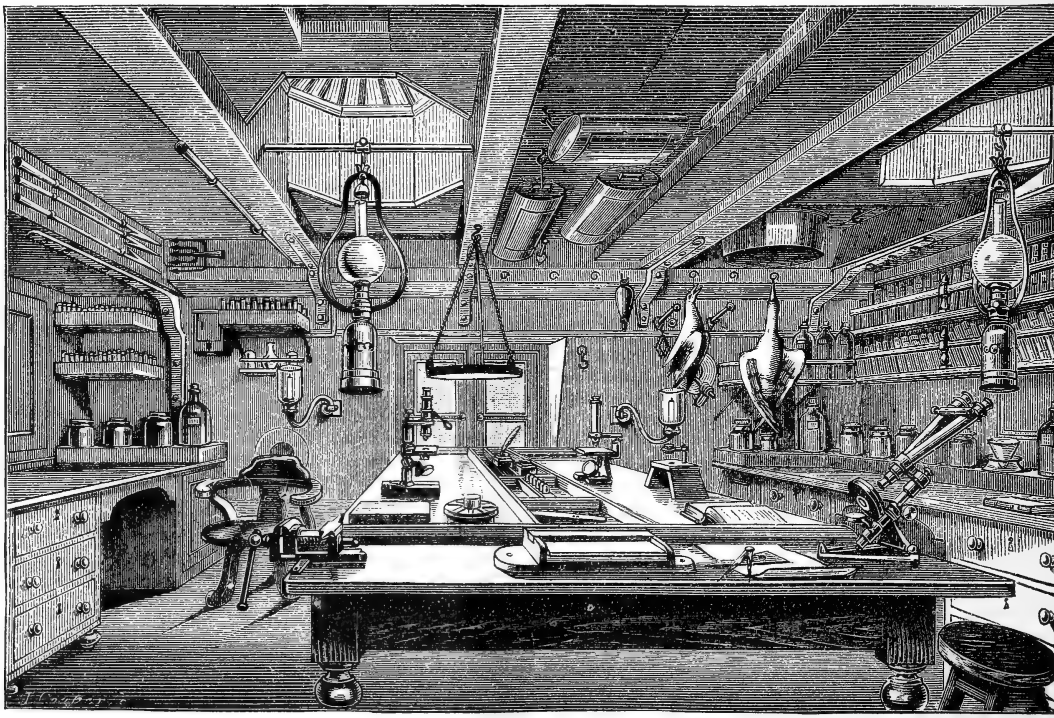
The history of the expedition, and the general nature of its discoveries, were long ago published to the world through Sir Wyville Thomson's 'The Atlantic,'[1] Professor Moseley's 'Notes,'[2] a work which should stand always on the same shelf with Darwin's 'Voyage of a naturalist,' Lord George Campbell's 'Log letters from the Challenger' (London, 1876),

[1] The voyage of the Challenger, — the Atlantic; a preliminary account of the exploring voyage of H. M. S. Challenger. 1878. 2 vols. 8°.

[2] Notes by a naturalist on the Challenger. London, 1879. 620 p. 8°.

Engineer Spry's illustrated journal in folio, with its hundreds of graphic sketches of scenery and incident,[1] and Mr. J. J. Wild's suggestive little books, 'Thalassa' and 'At anchor.'

The first-mentioned work, being semi-official in character, has been made the subject of much criticism, on account of the loose and inaccurate way in which many of the discoveries are announced. It is, in fact, a reprint of a series of letters to *Good words*, a family magazine, which were written by the director during the latter part of the voyage to satisfy public curiosity as to what had been done during its beginning. While it is undoubtedly open to criticism, it is probably as scholarly a piece of work as most landsmen would have been able to accomplish in the midst of the depressing influences of ship-life; and it is so much more satisfactory than any other official attempts at narratives which have yet appeared in connection with similar expeditions, that one cannot help regretting that the Pacific was not written up by the same hand and in the same manner. Sir Wyville Thomson has also been severely criticised for his policy in withholding the collections from the British museum, establishing the office of the expedition in Edinburgh, and refusing to ask the direct co-operation of the authorities of the British museum in working up his results. It is quite probable, to be sure, that a certain amount of additional support might have been gained by pursuing a different policy, but it is difficult to imagine whence it would have come. The British museum, like our own National museum, is the legal and proper place of deposit for government collections which have been worked up and reported upon, and the Challenger collections are gradually being sent there. The director of the expedition was, however, better fitted, both through experience and interest, to administer upon the collections brought together by his staff, than the officers of the natural history section of the British museum, no matter how much they may have excelled him as masters of special branches of work. Then, too, these men were already so overburdened with official routine that they could not have given the prominence to the Challenger work which it for the time de-



NATURAL HISTORY WORKROOM ON BOARD THE CHALLENGER.

[1] The cruise of her Majesty's ship Challenger. London, 1876.

served. The policy laid down by Professor Thomson, when called upon by the admiralty to propose a plan for the disposal of the Challenger collections, was in principle exactly consistent with that for many years pursued by our government geological survey, fish-commission, and bureau of ethnology, in relation to the national museum, though the heads of these organizations generally find it more convenient to use the organization of the museum to facilitate the administration of their own work.

A much more serious complaint has been based upon the policy of the director in claiming a right to control the results of the studies of his assistants during the voyage, and to announce their discoveries in his official capacity, without giving credit to the observers. It is, of course, impossible to say to what extent this policy was put in practice; but it is certain that the efficiency of the staff was to some extent impaired by it, and that some of the men felt called upon to protect themselves by writing their journals in languages unknown to the director. The subject has, of course, had no public discussion in England, and is referred to in this review simply on account of the general principle involved, which has already affected the efficiency of many institutions and expeditions in the United States. For the benefit both of science and of the workers in science, it is exceedingly important that there should be established some exact understanding of what constitutes literary or scientific property, and how much control over the results of the labors of his pupils or assistants a teacher or director justly may exert.

Whatever may have been the obstacles to the success of the expedition, its final results cannot fail to be satisfactory to every one who examines them. The highest praise is due to the late Sir Wyville Thomson, by whom it was organized and so successfully carried on. The liberal spirit with which he invoked the coöperation of foreign specialists was one of the many noteworthy features of his administration. Since his death, in March, 1882, the administration has been admirably carried on by Mr. John Murray, who was Professor Thomson's first assistant in natural history from the very start.

As has been already stated, eight volumes of zoölogical reports have already appeared. These contain the zoölogical monographs up to No. xxiv., thirty more still remaining to be published, together with two botanical reports, several concluding parts of papers already begun, and Mr. Murray's final summary of results. In discussing the publications of the expedition, the monographs will be taken up in systematic sequence. Their present order is arbitrary and temporary, it being understood that this will be abandoned in the final arrangement and combinations of the volumes of the report.

The mammal collections were assigned to Professor William Turner of the University of Edinburgh, whose paper upon the human crania is announced to be nearly ready, but whose final report on the marine mammalia will, it is feared, be long delayed. An instalment of the latter is, however, already in type, in the form of a report upon the bones of Cetacea (vol. i., 43 p., 3 pl.). This paper is a curious illustration of how many important facts may be derived from the study of a collection of objects of the most heterogeneous and miscellaneous character, such as the series of whale-bones gathered by such an expedition must necessarily be. The descriptions of the skeletons of Mesoplodon Layardi, and other whales obtained at the shore-stations, are valuable to the cetologist; but the greatest interest is in the account of the hundreds of separate bones dredged from the abyssal depths. At one station in the middle of the South Pacific, at 2,335 fathoms, there were obtained about ninety tympanic bullae, as well as numerous other ear-bones, the remains of nearly as many individual whales, most of them ziphioids. From the evidence of such fragments, Professor Turner concludes that the genus Mesoplodon is particularly abundant in the South Pacific, and Ziphius in the South Atlantic, though but few of these animals have been observed in those regions. Strange as it may seem, there were found no bones of the sperm-whale, so abundant in all the waters traversed by the ship. In the localities where bones were found, — none of which, it may be noted, were north of the equator, — the deposit at the bottom was a red clay, containing, besides the ear-bones, many hundreds of sharks' teeth, belonging to the genera Carcharodus, Oxyrhina, and Lamna, and apparently to extinct species. The question naturally arises, whether the associated cetacean remains belong to recent or extinct species. The occurrence of the teeth of tertiary sharks, lying so loosely upon the bottom that they may be scraped up by the dredge, indicates to the writer of this review that tertiary sharks have probably existed in these waters within comparatively recent times, and that the ear-bones, which cannot be referred to living species already known, in all likelihood belong to living species of whales not yet discovered. That interesting gener-

alized type of selachian from Japan recently announced by Garman under the name Chlamydoselachus is but one of the many signs that our knowledge of pelagic and abyssal life is still very incomplete.

Prof. D. J. Cunningham of the Royal college of surgeons, Ireland, contributes an essay upon the anatomy of certain marsupials and upon the mammalian *pes* (vol. v., 192 p., 13 pl.). The first part of this paper is descriptive, and devoted to Thylacine, Cuscus, and Phascogale; but its preparation led to a general investigation of the foot of mammals, involving the dissection of forty-five species distributed through all the orders. Professor Cunningham's conclusions as to the relations of the intrinsic muscles and nerves of the *pes* in different genera are of great interest, but, being merely incidental to the work of the Challenger, must be passed by with simple mention.

Vol. ii. is chiefly devoted to the report on birds, which is the eighth in the zoölogical series. This is a compound paper in thirteen parts, prepared by the standard British authorities, Sclater, Salvin, Saunders, Forbes, Tweeddale, and Garrod; one paper being also supplied by Salvadori of Turin, and one by Finsch of Bremen. The report on the anatomy of the petrels (Tubinares), by the late W. A. Forbes (vol. iv., 64 p., 7 pl.), is important as throwing much new light on the classification of these remarkable birds. It is based upon collections from the stores of the zoölogical society and the U. S. national museum as well as of the Challenger. The affinities of the petrels are shown to be with the Steganopoda and the storks and herons, rather than with the gulls. The most extensive anatomical monograph is that of the penguins, by Professor Morrison Watson of Owens college, Manchester, of which the first part has been printed (vol. vii., 244 p., 19 pl.). The publication of the second part will complete the ornithological work of the expedition. This essay is full of interest to the general reader as well as to the ornithotomist; since, although structural minutiae are fully discussed, each detail is brightened by some allusion to function, origin, or habit. The conclusions of Professor Watson, concerning the affinities of the Spheniscidae to each other and to other birds, are worthy of much fuller discussion. Many and appreciative allusions are made to Dr. Elliott Coues' monograph of the Spheniscidae, which is frequently quoted.

Professor W. Kitchen Parker's report on the development of the green turtle (vol. i., 58 p., 13 pl.) is an exceedingly weighty contribution to morphology, and concludes with a page of most suggestive generalizations upon the phylogeny of the Chelonia and Reptilia. This investigation was based upon a series of embryos obtained at Ascension Island, in compliance with Professor Parker's particular request, and is one of the most important of the side issues of the expedition.

Dr. Albert Günther's report on the shore fishes (vol. i., 82 p., 32 pl.) contains the identifications of fourteen hundred specimens, representing five hundred and twenty species, of which ninety-four were new. It consists of a series of faunal and regional lists, some of which, particularly those for remote oceanic islands, cover fields hitherto unexplored by ichthyologists; such as St. Paul's Rocks, Ascension, Kerguelen Island, and Juan Fernandez, and also Magellan Straits and the Arafura Sea. The systematic arrangement is all that can be desired: it is to be regretted, however, that the author has been satisfied to publish such brief and cursory diagnoses, and that he gives no tables of proportional measurements, thus causing serious embarrassment to students who have no access to his types. The report upon deep-sea fishes by the same author, at one time announced for vol. iii., is now so far down upon the official list of 'memoirs to follow in subsequent years,' that it is not likely to come to view for a long time. This is all the more to be regretted, since the fishes of the abyssal region are more peculiar, and more generally instructive, than perhaps the members of any other group. Much unstudied material in Italy, France, Austria, and America, is being held until these collections, now eight years in the author's hands, can be made known to the public. The preliminary descriptions published in 1878 are so meagre as to be nearly useless to any one except their author; and the type specimens themselves will, of course, be inaccessible for comparison until the final report is in type. Dr. Günther's success in re-organizing the natural history section of the British museum has been very great, yet it seems unfortunate that administrative work should so entirely monopolize the time of so eminent an ichthyologist.

RAIN IN BELGIUM.

La pluie en Belgique. Par A. LANCASTER. Bruxelles, *Hayez*, 1884. [Extract from the Annuaire de l'Observatoire royal de Bruxelles.] 113 p. 16°.

THE completion of a fifty-years series of uninterrupted observations of rainfall at Brussels

is taken by Lancaster as a fitting occasion for the preparation of a neat compendium of rain-records for all Belgium. The longer series, besides Brussels, are forty-three years at Ghent, thirty-five at Liége, twenty-three for Ostende, and twenty for Les Waleffes. The entire list, prepared for the end of 1882, contains one hundred and twenty-seven stations, with an average record of four and a half years; but of these, thirty-eight are for only one year, and sixty are for two years or less. At present the observatory receives the results attained at over two hundred stations. The chief general conclusions, which, unfortunately, are not shown either by map or diagram, are as follows: along the littoral lowlands an annual fall of about 650 millimetres, rising to a maximum in the highlands of the Ardennes (altitude about 400 metres) of from 900 to 1,100 millimetres. For 1882, rain and altitude of station are thus related: —

Below 10 m.	825 mm.	200 to 400 m.	1,220 mm.
10 to 100 "	875 "	400 to 700 "	1,375 "
100 to 200 "	1,020 "		

According to seasons, the ratios are, winter, 100; spring, 95; summer, 129; autumn, 119. Along the coast the maximum is in autumn: in the interior, it is in summer. Heavy rains occur chiefly in the summer. In Brussels, since 1833, there have been sixty-nine records of 25 to 50 millimetres of rain in a day, thirty-four of these being in June, July, and August. A general increase in the annual rainfall is suspected since 1865, the evidence being as follows: —

Ghent	1838-64, 753 mm.	Ghent	1865-82, 981 mm.
Brussels	1833-64, 700 "	Brussels	1865-82, 778 "
Liége	1847-64, 743 "	Liége	1865-82, 796 "

The sun-spot cycle does not find strong confirmation from the records at Brussels.

Minimum.		Maximum.		Difference.
1833	646 mm.	1837	714 mm.	68 mm.
1843	736 "	1848	750 "	14 "
1856	670 "	1860	695 "	25 "
1867	682 "	1870	737 "	55 "
1878	818 "	1882 4	824 "	6 "

The little volume is chiefly valuable as bringing the older records up to time, and preparing for future work with the greatly increased number of stations of the past few years.

A NEW ASTRONOMICAL JOURNAL.

Bulletin astronomique, publié sous les auspices de l'Observatoire de Paris. Par M. F. TISSERAND. Tome i., No. i., Janvier. Paris, *Gauthier-Villars*, 1884. 64 p. 8°.

THE great number of new observatories in France now beginning active work has rendered a publication of this character a necessary adjunct of the labors of the astronomers of that country; and it will embrace two distinct parts, the first of which will contain the late observations made at the French observatories, ephemerides of planets and comets, and memoirs and notices relating to various topics in theoretical and practical astronomy. The second part is to be devoted to notices of current astronomical news, and a *résumé* of the chief periodical publications and of memoirs. This latter feature is a most fortunate one, and will make the *Bulletin* a desideratum in all observatories and scientific libraries. The special periodicals embraced in the *revue* of the January *Bulletin* are the *Monthly notices* of the Royal astronomical society, *The observatory*, the *Sidereal messenger*, the *American journal of science*, *Copernicus*, and the *Astronomische nachrichten*. The first part of the same number contains a brief paper by Tisserand, on the theory of the motion of the small planet Pallas, followed by observations of the satellites of Mars and Neptune by the Henrys, of the comet Pons-Brooks by Bigourdan and Perigaud, — all these at the Paris observatory, — and observations of the latter object by Trépied, at Alger; ephemerides of the small planets Mnemosyne, Diana, Alcmene, and Parthenope; and is concluded with the first part of a paper by Schulhof and Bossert, on the late return of the comet of 1812. Appended to the January *Bulletin*, under the head of *Variétés*, are, a paper on *les phénomènes crépusculaires*, by Radau; the comets and planets of 1883, by Bigourdan; and the new observatory of Rio de la Plata.

It would be a matter of the greatest interest to those engaged in new and original research, if a department relating to unpublished investigations could be added to the *Bulletin*. Brief notes in such a department, relating to work already in hand, its progress at various stages, and to projected research, the material for which may be in process of accumulation only, would be likely to lead to a more effective and happy state of co-operation among astronomers and observatories than now exists.

The *Bulletin astronomique* is published from the press of Gauthier-Villars, and is gotten up in the attractive style, and with that good typo-

graphic taste, which characterize the house of this *imprimeur-libraire;* and, being under the immediate charge of so eminent and able an astronomer as Tisserand, we venture to predict for the new journal an auspicious future. Tisserand will have as *collaborateurs* Callandreau and Bigourdan of the Paris observatory, and Radau; and the *Bulletin* is expected to be issued hereafter at the beginning of each month.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Paleozoic paleontology. — During March the survey turned over to the National museum the collection of Devonian fossils from the Eureka district of Nevada. It embraces the Devonian fauna of central Nevada, described by Mr. Charles D. Walcott in the paleontology of the Eureka district, exclusive of the Actinozoa and Bryozoa. It contains 2,397 specimens, including 203 species, 89 of which are Brachiopoda, 44 Lamellibranchiata, 40 Gasteropoda, 11 Pteropoda, 9 Cephalopoda, 3 Crustacea, and 7 Poecilopoda.

During the last field-season, Mr. C. D. Walcott and his assistants spent some time in the study of the Potsdam localities in New York, and considerable collections were sent in to the office of the survey. He is now engaged in the preliminary preparation and study of material to illustrate the Cambrian fauna of the United States. It is very desirable that large quantities of material should be brought together from all the Cambrian groups; and the survey would be glad to receive collections, whether large or small, from all portions of the country. Care should be taken in packing, and a record kept. Correspondence has been begun with numerous collectors in Wisconsin, in order to obtain material from the Potsdam group.

Mesozoic paleontology. — Dr. C. A. White, in charge of this branch of paleontologic research, has lately prepared a bulletin on mesozoic fossils. It is illustrated with nine plates, and contains three papers devoted respectively to the mesozoic fossils of Alaska, Arkansas, and Texas. Hyatt's new genus, Enclimatoceras, is described and illustrated in this bulletin. The fourth annual report, which is just about being issued, contains a paper of sixty pages, with forty-nine plates of illustration, entitled "A review of the fossil Ostreidae of North America, and a comparison of the fossil with the living forms."

Dr. White is making preliminary studies of fossils from the Pacific coast, preparatory to visiting that section to undertake a special study of its mesozoic and cenozoic faunas.

At intervals ever since 1880, Dr. White has been engaged in the description of the mollusks and echinoderms of the cretaceous formation of the provinces of Sergiee, Pernambuco, Bahia, and Para, in Brazil. The collections were made by the Imperial geological survey of Brazil, in charge of Ch. Fred. Hartt. Dr. O. A. Derby, his former assistant, is in charge of the geological division of the National museum of Brazil, under the auspices of which this work is done. The specimens described include 82 species of Conchifera, 91 of Gasteropoda, 13 Cephalopoda, 11 of fresh-water faunas, and 15 echinoderms. Among them he has established four new genera. The specimens are all referable to the Neocomian series, as is also a fresh-water fauna from Bahia, described in the same volume. The manuscript, with twenty-eight quarto plates of illustration to be lithographed, is now ready for the printer, and will be published in Portuguese in the *Archivos* of the Brazilian national museum. It is expected that the descriptions, at least, will also be published in English. Dr. White finds that this cretaceous fauna is quite unlike any in North America, but more like that of southern India. A portion of the specimens have been identified with some described by Stoliczka in the 'Paleontologia Indica.'

Mr. J. B. Marcou, Dr. White's assistant, has been busily engaged in sorting and arranging the type specimens described by Prof. F. B. Meek in the various reports of Hayden, King, and other government publications. Many of the types of Conrad and Whitfield are also in the collections that he is arranging.

Mr. L. C. Johnson, who is in the same division, is arranging the large collections of fossils made by him in the Gulf states last summer, and is preparing geological sections from his notes taken while collecting these fossils.

Vertebrate paleontology. — Prof. O. C. Marsh, who is in charge of this division, reports progress in the preparation of the various memoirs, and states that field-work which began in April starts under good auspices, careful preparations having been completed to place four parties in the field early in the season, to be followed by others later.

Paleo-botany. — Among the collections of fossil plants made by Prof. L. F. Ward from the Fort-Union group in the upper Missouri and Yellowstone region, a number of new specimens have been found, which will eventually be published in Professor Ward's memoir on the subject. Professor Ward at present is engaged on the introduction to this work, in which he proposes to review the subject of paleobotany from the historical, geological, and biological stand-point. The work of figuring the types from the Fort-Union collections has been commenced, and a card-catalogue has been made of all the species of fossil plants in the National museum, which renders it much more available as an aid to research than it has ever been before.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Chemical society, Washington.

April 24. — Thomas Taylor presented a paper upon oleomargarine, butter, and butterine, in which he described methods for the recognition of imitation-butter by means of the microscope, polariscope, and sulphuric-acid test. Under the microscope, oleomargarine shows marked crystallization, pure butter is perfectly even, and butterine contains excess of oily matter. With sulphuric acid, butterine gives a yellowish tint, which passes through a brownish amber to a final vandyke-brown color. Oleomargarine gives a yellow color, which gradually deepens to a red or crimson. With butter, sulphuric acid produces a whitish tinge at first, which soon changes to a salmon color, but never becomes crimson. If the butter has been colored with annatto, the color will be bluish green to black at first, but brick-red or salmon afterwards. With the polariscope and selenite plate, butterine gives a uniform plain tinge, red or green, while oleomargarine is distinguished by the colors produced by fat crystals.—— Dr. T. M. Chatard gave an account of a modified process for the estimation of alkalies in silicates, which is based upon Hempel's method of decomposition with bismuth oxide. One part of the pulverized mineral, intimately mixed with two parts of bismuth oxide, is heated to redness over a Bunsen burner for about twenty minutes. The mass is then decomposed by strong hydrochloric acid; the excess of acid is evaporated off; the diluted solution is precipitated by ammonia and ammonia carbonate, and filtered. In the filtrate are the alkalies and magnesia, to be separated by the usual method. The process is easy and rapid. —— Mr. E. Richards next gave some notes on the specific gravity of milk and whey. The whey seems to be more constant in specific gravity than milk. —— A. E. Knorr and H. W. Wiley described the manufacture and use of very thin glass dishes for certain purposes in the analysis of organic products. The dishes are so thin and light that they may be pulverized, with their contents, preliminary to the combination analysis of the latter. Several of them were made before the society.

Natural science association, Staten Island.

April 12. —Mr. Charles Butler read a paper on experiments upon cross-breeding of moths. Last July he placed a recently hatched female of Callosamia Promethea out-doors in a box to secure some males of the same species, but caught six male C. angulifera within an hour of the time of the first exposure. The following night he caught five more with a new female, and the next night only one, and no C. Promethea. He noticed the fact that both of these species are not found about the vivarium at the same time. C. Promethea comes in the afternoon, when the sun is still up: C. angulifera comes after sunset. Mr. Bruice of Brockport says that a female Samia ceanothi, a California species hatched by him, attracted the males of S. Cecropia in great numbers. Mr. Pilate of Dayton, O., states that he tied a female S. Cynthia out-doors over night, in order to obtain some eggs, and the next morning found her attached to a male S. Cecropia. Mr. Cook of Lansing, Mich., had a female S. Cecropia that attracted a score or more of S. Columbia.

Society of arts, Massachusetts institute of technology.

April 10. — Mr. Thomas Pray, jun., spoke on the subject of the cotton-fibre and its structure, as shown by the microscope. A photograph was shown of a stalk carrying two hundred and twenty-five ripened bolls: and it was stated, that by the method lately practised, of developing this variety by carefully selecting the seeds of the best bolls, and planting them apart from others, and continuing this process during several years, it had been conclusively proved that it was perfectly possible to bring the yield of lowland cotton up to three bales per acre, with proper fertilization and favorable season; whereas, at present, a yield of one bale per acre is very large, the average being less than one bale to two acres. In the method of ginning at present practised, the seeds of all the different varieties of cotton ginned are indiscriminately mixed; and the planter who brings his cotton to the gin, though receiving the same cotton back again, gets, for every bale ginned, a certain number of bushels of this miscellaneous mixture of different seeds, from which his next year's crop is planted. No pains whatever have been taken to develop good varieties of cotton, or to increase the yield per acre by a process of selection, except in rare cases within a few years. A number of photo-micrographs of cotton-fibres were shown, exhibiting their peculiarities of structure. The fibre is a wide or flat cylinder, with a thickening at the edges, and thin in the centre, twisted into a spiral. The coloring-matter is oily or resinous, and, in drying, is deposited on the edges of little pockets occurring along the fibre. The better the fibre, the more perfect its spirality, and the more regular in shape and in position are these oily deposits. Wrinkles are also formed in the fibre when drying, becoming most marked in the perfectly matured dry fibre, thus affording another test of good cotton. The lack of spirality prevents the fibre from being twisted with others in such a way as to become intimately engaged with them. An illustration was shown of the cotton after it had passed through the saw-gin, clearly showing that the fibres had been torn apart, the ends showing plainly the mutilation by the saw-teeth. The speaker referred to the faults of the present methods of ginning, and pointed out the directions for improvement. An illustration was also shown of cotton, after passing the railway head, which is supposed to make the fibres parallel; whereas such is by no means the case. The speaker urged the importance of examining cotton by the microscope, and dwelt upon the advantages which manufacturing corporations would gain by selecting their stock in this way.

NOTES AND NEWS.

THE following is the list of subscriptions sent to the editor of *Science* for a memorial tablet inscribed with the name of JOACHIM BARRANDE, to be placed on the side of a cliff at Kuchelbad, near Prague, Bohemia: Professor Alpheus Hyatt, Boston, $10; Dr. Carl Rominger, Ann Arbor, $10; John Collett, state geologist, Indianapolis, $2; Professor Jules Marcou, Cambridge, $4; S. H. Scudder, Cambridge, $10; and the following from gentlemen connected with the U. S. geological survey: Major J. W. Powell, $5; C. D. Walcott, $5; Dr. C. A. White, $5; Dr. A. C. Peale, $1; G. K. Gilbert, $3; Capt. C. E. Dutton, $1; Prof. T. C. Chamberlin, $3; W. J. McGee, $2; J. B. Marcou, $2; Prof. H. S. Williams, $5; Prof. S. G. Williams, $2; S. F. Emmons, $2: total, $72. A draft for 175.60 Austrian florins was forwarded, on Monday last, to Dr. Anton Fritsch of the Prag museum.

— The first number of the *Bulletin of Massachusetts natural history* has appeared. The contents, unfortunately, show no justification for its existence, either for the interests of the natural history of Massachusetts, or as a record of work in the State agricultural college, which its circular declared to be its two special objects.

— The *Kölnische zeitung* of April 10 states that Dr. Koch, the head of the German scientific commission for the investigation of the cholera, has submitted a seventh report, dated Calcutta, March 4. It mentions the important discovery that the storage-basins called tanks have proved the locally limited seat of cholera infection and communication. Little ponds or swamps, scattered over all Bengal in large numbers, surrounded by cottages, furnish to the dwellers near them their water-supply, and are used for various purposes, — as for bathing, clothes-washing, for cleaning domestic utensils, and also for drinking-water. After the commission had in vain sought for the cholera bacillus in numerous trials of tank, sewage, and river water, they are discovered for the first time in a tank in the midst of the cholera district. Since the last report, the bodies of twenty cholera victims, and the excrements of eleven patients, have been examined. The whole number of cases examined in India now amounts to forty-two dead bodies and twenty-eight patients. The last cases have not, to be sure, yielded new results. They resemble the others in every particular, especially in reference to the behavior of the bacilli. In addition, there are still in progress investigations concerning the influence of various substances — as sublimate, carbolic acid, and other disinfectants — on the development of the cholera bacilli in culture-fluids; also concerning their behavior in carbonic acid, and deprived of air. Attempts to discover a lasting form of the bacillus were also continually made. Up to the present time, nothing of the kind has been discovered. The only possibility of getting bacilli capable of living a longer time is to keep them from drying. In liquids they remain for weeks capable of development, and every thing seems to indicate that only in a moist condition can they be preserved, and then made to act on human bodies. Unfortunately, on account of the warm weather, which this year begins early, further investigations on this subject must be abandoned. Dr. Koch is returning to Europe.

— The first general meeting of the British association at Montreal will be held on Wednesday, Aug. 27, at 8 P.M. precisely, when Professor Cayley will resign the chair, and Professor the Right Hon. Lord Rayleigh, president-elect, will assume the presidency, and deliver an address. On Thursday evening, Aug. 28, at 8 P.M., there will be given a *soirée;* on Friday evening, Aug. 29, at 8.30 P.M., a discourse, by Prof. W. G. Adams; on Monday evening, Sept. 1, at 8.30 P.M., a discourse on 'The modern microscope in researches on the least and lowest forms of life,' by the Rev. W. H. Dallinger; on Tuesday evening, Sept. 2, at 8 P.M., a *soirée;* on Wednesday, Sept. 3, the concluding general meeting will be held at 2.30 P.M.; Saturday evening, Aug. 30, a lecture on 'Comets,' by Prof. R. S. Ball, of Dublin university, and astronomer royal for Ireland (this does not appear in the association circular, as it is intended for the citizens of Montreal).

— An informal meeting was held April 12, in Philadelphia, to discuss the plans of the proposed department of biology at the University of Pennsylvania. A fund of a hundred thousand dollars is to be raised to allow of an expenditure of fifteen thousand dollars for a building, the balance to be invested for the support of the institution. Twenty thousand dollars have already been subscribed, and the contracts for the building will soon be given out. A committee consisting of Hon. John Welsh, Dr. Leidy, Dr. Alice Bennett, Mrs. S. A. Crozer, Dr. Horace F. Jayne, Miss Ida Wood, and Miss Mary Thorn Lewis, was appointed to carry out the purposes of the meeting.

— At the meeting of the French academy on March 31, Mr. Charles Brongniart announced the discovery, in the rich carboniferous deposits of Commentry, of new gigantic forms of insects, of the type of Dictyoneura, in which the expanse of wings was nearly twenty-eight inches.

— Among recent deaths, we note that of Abbé Brugnone, the paleontologist, at Palermo, on the 3d of February, in his seventieth year; that of Dr. E. Behm, editor-in-chief of Petermann's *Geographische mittheilungen*, already noticed, occurred at Gotha, on the 15th of March; Capt. Niels Hoffmeyer, the director of the meteorological institute at Copenhagen, died at that place, the 16th of February.

— It is proposed to collect as complete a set of books on electricity as possible, to be shown at the International electrical exhibition in Philadelphia this autumn. After the exhibition the collection will be placed in charge of the Franklin institute, and will form the nucleus of a reference-library.

— E. and F. N. Spon announce as in preparation 'The electric light,' by E. Alglave and J. Boulard, translated from the French by T. O'Connor Sloane.

SCIENCE.

FRIDAY, MAY 16, 1884.

COMMENT AND CRITICISM.

THOSE interested in making out the connection between the periods of recurrence of the solar spots and every kind of meteorological phenomena, crops, panics, and the like, will derive little that is comforting from the unusual spottedness of the sun's surface of late. Just as astronomers may be said to have concluded that the sun-spots wax and wane according to some pretty regular period, the length of which appeared to be determined with a fair approach to the desired accuracy, the sun itself interrupts the continuity of their successful prediction by an abnormal lagging of the present maximum: for the epoch of this phenomenon, as inferred from the best interpretation of the records of the past, lies somewhere in the year 1882, or the early part of the year following. In point of fact, there appears to be ground for doubting whether the true maximum may not, even now, be a thing of the future.

Rather less of encouragement will those astrological theorists of sun-spot periodicity receive who stand stoutly for the notion that the increase and decline of the spots are traceable to planetary position and influence, even if there were no other spot-phenomena, which this theory is powerless to explain. And the meteor-origin theorists are in almost equal difficulty. On the other hand, the more plausible explanation of this periodicity — that the solar globe determines within itself, and independently of all exterior perturbing action, the extent and duration of the absence or prevalence of the spots on its surface — receives re-enforcement rather than otherwise from the present manifestations of spot-activity; for, on this theory, the periodicity is more likely to be irregular than the reverse. The new periods of short duration, discovered by Professor Stewart, are likewise, on this same basis, accounted for most easily, and with greater accuracy. The likelihood that solar energy, as displayed in spot-production, has been on the increase during the year 1883, and the certainty that it has not largely waned since that time, render it very probable that we have not yet accumulated sufficient data for deciding with exactitude upon the true epoch of the present spot-maximum.

D. H. TALBOT of Sioux City, Io., has addressed an open letter to the Hon. W. B. Allison to advocate the establishment of a zoölogical preserve within the boundary of the Yellowstone Park, where bears and deer shall be enticed to breed and abide, defended by a guard from human encroachment. There is to be an honest, competent observer in charge, who is to make notes, which may "be published in like manner as the reports of the Smithsonian institution." Mr. Talbot's scheme is vague; its opponents will call it visionary: nevertheless, we entirely agree with him as to the interest and value of reserving some territory where our large mammals may be secure from extirpation; but we do not feel assured, that if, as Mr. Talbot proposes, three species of bears are to be brought within one comparatively small territory, together with some ten other animals, mostly deer, all the happy family will survive the intensified struggle for existence. Nevertheless, Mr. Talbot's scheme is a valuable suggestion, which we trust will receive careful consideration from the proper authorities.

SHORTLY after the announcement of the law of storms by Dove and Redfield, fifty years ago, mariners became familiar with the expressions 'dangerous' and 'manageable semicircle,' referring to the sides of the storm-disk where the velocity of the winds was respectively re-en-

forced and diminished by the progression of the storm. But on lands in the temperate zone these terms have had little application; for there cyclones proper are seldom destructive, and, as a general thing, do less harm by their winds than they do good by their rains. There will, however, soon be need, at least in our western and southern states, of a corresponding expression, such as the 'dangerous octant,' to denote the sector between south and east of the broad storm where local tornadoes may be developed; for the surmise that tornadoes were thus definitely related to cyclones, suggested by the signal-service studies of a year or two ago, is rapidly becoming a well-proved fact by the investigations of this season. It is the most interesting discovery in meteorology that has been made of late years, in its theoretical as well as in its practical bearings.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Radiant heat.

In his letter to *Science* of the 15th of February, Professor Eddy states, that, in his opinion, the direction of the rays entering the region B is immaterial. As I am sure no other American or other scientific man agrees with him, I do not think it worth while, now that the issue has been reduced to this question, for me to continue a correspondence of the kind across the Atlantic, especially as Professor Eddy's mistakes have already been pointed out by Professor De Volson Wood.

As I am writing, I may, however, as well point out Professor Eddy's mistake in the arrangement he proposes as a substitute for mine. I agree that fig. 1 and fig. 2 represent what would happen; but fig. 3 does not represent all that would happen, as evidently, if heat can go into B in the direction $y'z$, as in fig. 2, there would be an escape of heat from B in the direction zy', as well as that in the direction zy represented in fig. 3; and so, to the two quantities of heat coming into B in fig. 2, there would escape two equal quantities, which should have both been represented on fig. 3; and then, evidently, B is no better off than before.

Professor Eddy, I hope, will recollect that a pencil of rays of infinitesimal angle can only contain an infinitesimal quantity of heat. I make the remark because an omission to notice this fact is the only excuse I can see for the curious remark in the penultimate paragraph of his letter.

Geo. Fras. Fitzgerald.

Trinity college, Dublin.

Another 'yellow day.'

On the afternoon of May 2 a strong wind from the south-west brought to our position (seven miles due west of West Point) thick clouds of smoke from the forest-fires in Pennsylvania and northern New Jersey. At 4.15 P.M. the sun had become completely obscured, and occasionally cinders and bits of charred leaves were borne past by the wind. The increasing density of the smoke was accompanied by a strange brassy, yellow light, which grew more vivid as the sun disappeared, and was most brilliant from five to six o'clock. It pervaded the whole sky with a diffused brassy glow, which was reflected into interiors so that an object placed before a window cast a perceptible shadow, yet the actual amount of light was less than in ordinary foggy or cloudy weather. The flame of a student-lamp had a white, dazzling appearance, not unlike the electric light. The green color of grass and foliage became of a most vivid quality, and the various shades of red seemed unusually prominent. This was attended by a high wind of from thirty to forty miles per hour, the highest temperature of the season, falling barometer, and a remarkably low percentage of relative humidity, as the following records show in part:—

Hour.	Temperature.	Relative humidity.
1 P.M.	81.0°	44%
2 "	82.0	38
3 "	81.5	33
4 "	81.0	22
5 "	80.0	15
6 "	67.0	42
7 "	61.0	45

The noteworthy feature of the phenomenon was its similarity to that of the well-remembered 'yellow day,' Sept. 6, 1881, the explanation of which was the subject of so much discussion. But, since the cause of the later occurrence was so unmistakably the presence of smoke in the air, persons who witnessed both can have little doubt that the same cause operated in the former case.

Winthrop E. Stone.

Houghton Farm, Orange co., N.Y.

Cretaceous phosphates in Alabama.

I send you by mail some specimens of phosphatic nodules recently discovered in Perry county, in this state. Their true character was first suspected by Mr. William Spencer, on whose land they are found in abundance. Specimens were sent by him to Dr. C. U. Shepard, jun., of Charleston, S.C., and to myself, for examination, with the result of showing that they were nearly pure phosphate of lime. The geological position of this occurrence is different from that of the South-Carolina phosphates, as they are found at the base of the cretaceous rotten limestone; but the mode of occurrence is quite similar, as may be seen below.

A section (descending) of the strata at Hamburg, in Perry county, is about as follows:—

1. Rotten limestone, only the lowermost beds of which are here present.
2. Greensand beds from one to four or five feet in thickness. These beds appear to be impregnated with phosphoric acid; analyses of several specimens, selected from different spots, showing an average of about twenty per cent.
3. Sandy, calcareous beds about six feet in thickness. Where these beds outcrop in the fields, the surface of the ground is covered with nodules similar to the specimens sent herewith. These nodules

vary in size, from small pebbles no larger than a pea, to pieces an inch or more in diameter. They are of very irregular shapes, and of colors varying from light bluish gray to dark brown. When rubbed together, they emit the peculiar 'naphthous' odor which characterizes the South-Carolina phosphates. I collected and weighed the loose specimens from a square foot of surface: the weight was about two pounds, which would correspond to some forty-three tons to the acre. I was not able to ascertain whether the nodules were distributed through the whole of stratum no. 3, or whether they were confined to a distinct layer therein, though a number of sections were examined; nor can I as yet state the probable yield per acre in these nodules, but investigations are now in progress which will probably soon give some more definite information on this point. Associated with the nodules are great numbers of fossils, consisting of fragments of Nautili, of Ammonites, of Baculites, and other well-known cretaceous forms. In most instances these fossils are phosphatized more or less completely, in extreme cases to the extent of nearly obliterating the organic structure; and then the fossils resemble the nodules very closely. In addition to these are found many vertebrae, and other bones of saurians, and teeth of sharks, among which are some very large 'pavement' teeth. I have had several analyses made of the nodules, and find the content of phosphoric acid to be from twenty-five to thirty-eight per cent.

4. Indurated ledge of light-colored sandy marl from a foot to eighteen inches in thickness. This stratum, which is quite persistent, holds about ten per cent of phosphoric acid, the average of several analyses of samples taken from different localities.

5. Loose whitish calcareous sands, passing downwards into micaceous sands, and, at the depth of twenty to thirty feet below the ledge no. 4, passing into compact bluish sands, with considerable greensand.

The whitest sands, at the top of these beds, hold in places compact beds of small oyster-shells. The sands just below the ledge no. 4 are also impregnated with phosphoric acid; and, though no quantitative analysis has yet been made, the percentage, judging from appearance, cannot be less than ten. We have thus eighteen or twenty feet of strata charged with phosphoric acid; the content of this acid varying from ten per cent in the lower beds, to twenty per cent in the greensand at the top. No analyses have yet been made of the beds which hold the nodules.

Of the economical importance of this discovery it is as yet impossible to speak definitely, but, if the greensand beds can be made available, the yield will be very large; and the nodules may yet be found in compact masses instead of loose pebbles.

It is probable that phosphate beds, in similar geological position, may be traced across the state; and already some greensands from Eutaw have been analyzed, and found to contain eight per cent of phosphoric acid. The following towns are situated near the line of contact of the rotten limestone and the underlying sandy strata: Tuskegee, Montgomery, Vernon, Autaugaville, Burnsville, Summerfield, Hamburg, Greenesboro, Eutaw, Clinton, Pleasant Ridge, Bridgeville, and Pickensville in Alabama, and Columbus, Aberdeen, Cotton-gin Port, Guntown, Baldwin, Booneville, Rienzi, and Farmington in Mississippi; and it is well worth while to search along this line for other occurrences of phosphates, especially where the saurian bones and sharks' teeth are abundant. EUGENE A. SMITH.

University of Alabama, May 3.

A blind fish from the Missouri River.

An old fisherman on the river brought me yesterday an anomaly which none of his craft had ever seen before. It was a shovel-nosed sturgeon (Scaphirhynchops platyrhynchus (Raf.) Gill), which exhibited on the surface no sign whatever of eyes. These were concealed by a complete overgrowth of the prickly skin, which, on casual examination, differed in no respect from its normal appearance elsewhere. Upon very close inspection, however, a slight indentation, like a small pin-prick, was found to mark the place where one eye ought to be, but it did not penetrate the skin; and even this could not be detected over the other eye.

I skinned and mounted the fish, and, after skinning, removed the eyes from the inside through the mouth and gill openings. In one of these I could detect nothing abnormal. The other was without the crystalline lens, though the cornea and iris were apparently in place when I took it out; but, as it was removed with considerable difficulty, the lens *might* have been pressed out in the process. The first-mentioned eye was taken out with more care and less difficulty, and was entirely uninjured.

The sturgeon was normal in every other respect, twenty-five inches long to the tail, and showed no sign of injury to account for the monstrosity. It was in as good physical condition as others of its kind, so far as I could see, and seemed to have labored under no unusual disadvantage in its struggle for existence. The alimentary canal contained several insect larvae, the only contents that could be recognized. Most of these were so far digested as to be beyond identification. One, about an inch long, had rudimentary mouth-parts and no legs, and might have been a dipterous larva. Two fragments resembled the larva and pupa of some Lampyridae. Another was a lamellicorn beetle larva, probably of Lachnosterna fusca Fröhl.

As the habit of this sturgeon is to plough in the mud for its food, and to use its tactually sensitive barbels, with perhaps the soft skin covering the under surface of its shovel-nose, as a substitute for sight, it can have but little use for eyes: hence they might about as well be covered with skin, or become rudimentary, as those in the blind fishes, cray-fishes, etc., in Mammoth Cave and in certain subterranean streams and ditches, and for the same reason.

The eyes of this species are very small for its size, and especially small as compared with the eyes of most fishes. So the mole has its eyes reduced to a mere speck, which doubtless, as Mr. Huxley says, 'have no functional use.' It seems, therefore, not unreasonable to suppose that this unfortunate sturgeon's closed and sightless eyes may be only a prophetic instance of the fate which *awaits* all that belong to this species, and that even the normal eye is already considerably advanced in the process of abortion. S. H. TROWBRIDGE.

Glasgow, Mo.

The use of the method of rates in mathematical teaching.

In regard to the communication of Professor Johnson, in your issue of April 18, p. 473, he admits that he is puzzled by the form of the questions which he assumes I put into the mouth of my students. I had no intention of puzzling him; and, in regard to the questions, they were real samples of those proposed by students from time to time. Not that all were asked by one student, or during one discussion, nor limited to those given.

My students have not asked me "whether the positive and negative parts of the axis of x are separated by a point, or by a space." Their difficulty does not appear to be with permanent statical conditions, but rather with the conditions involving change of motion, either of direction or change of rate; and since *rate*, in this discussion, involves motion, we fail to see the force of the question.

Professor Johnson expresses the opinion that the difficulty in the question, "Does the change in the rate of motion take place *at* an instant, or *during* an instant?" will disappear if 'during an interval' be substituted for 'during an instant.' We do not object to the substitution if it will relieve the difficulty, but to us it only enlarges it. It may be asked, How long is the interval? If ever so small, is the rate variable *during* the interval? If variable, the original question arises, and we wish to know if *change* involves *a part* of the interval; or, to adopt as nearly as possible the language of the professor, does change in the rate take place at 'a point' in the path, or during 'a space' of the path? If at 'a point,' is it not equivalent to asserting that a change takes place in no time? and if an interval is necessary, must it not be conceived as infinitesimal? Answers to these and similar questions may enable one to decide whether the fundamental conception of rates is more simple than that of the infinitesimal method. I do not question the soundness of the method of rates; and no avenue to the acquirement of knowledge should be closed to the student, even if all are not agreed that it is the 'fittest.'

DE VOLSON WOOD.

Hoboken, May 8.

THE NAUTICAL ALMANAC OFFICE.

THE conduct of the affairs of the office of the American ephemeris and Nautical almanac under the *régime* of the present superintendent, is worthy of special note in the progress of astronomy at home. Formerly this office did very little toward the collection and discussion of data for improving the tables of the celestial motions, expending nearly the whole of its annual appropriation by congress in the preparation of the Almanac and the Ephemeris from such tables as were afforded by the labors of astronomers everywhere, and, with few exceptions, not connected with the office itself. During the past seven years, however, not only has the efficiency of the office been greatly promoted by having nearly, if not quite, all the planetary ephemerides prepared by a single expert computer under the immediate direction of the office, and by a similar concentration of work and workers in other departments where formerly the computations were executed by individuals in different parts of the country not under the direct supervision of the superintendent, but the policy of the office with regard to the conduct of original investigation has been greatly modified; and, although the increase of the annual appropriation has been very slight, an immense amount of astronomical research has been completed and published; and, as we learn from the published papers and reports of the office, the work, now well progressed and projected for the future, is of a character even more important and extensive. The valuable series of 'Astronomical papers prepared for the use of the American ephemeris and Nautical almanac,' the third volume of which has just begun with the publication of Professor Newcomb's development of the perturbative function, has for its object a systematic determination of the constants of astronomy from the best existing data; a re-investigation of the theories of the celestial motions; and the preparation of tables, formulae, and precepts for the construction of ephemerides, as well as for other applications of the results. The papers already published in the second volume, and the six parts of the first volume completed some time ago, are such as conduce only to the object in view, and range over a vast field of astronomical inquiry, from the experimental determination of the velocity of light, to Gauss's method of computing secular perturbations. Among the more important works already well in hand, but as yet unpublished, are Mr. George W. Hill's development of the perturbations of Jupiter and Saturn according to the methods of Hansen, on which he has been engaged since 1877; a determination of the mass of Jupiter from the perturbations of Polyhymnia; a re-determination of the velocity of light by the phototachometer; as well as discussions of the older observations of the Sun, Mercury, Venus, the Moon, Mars, and the satellites of Jupiter, with a direct view to a reconstruction of the theories of the motions of these bodies.

Not among the least of the improvements inaugurated by the present superintendent of the office must be noted the material alterations in the form and arrangement of the contents of the American ephemeris, together with the extensive additions made for the first time to the volume for the year 1882; all of which conspire, on the adoption of the new and more accurate systems of planetary tables, to make the Ephemeris in most respects superior to the similar publications of the foreign governments. The administration of the office also gives good evidence that the practical applications of astronomy are kept well in mind; for within a brief period it has commenced the regular publication of the American coaster's nautical almanac, the initial volume of which is adapted to the present year, and which we shall shortly notice.

INDIAN IMPLEMENTS OF THE NORTH-WEST.

A Dakota puk′-gah-máh-gun.

THE illustrations accompanying the present paper represent a Dakota puk-gah-mah-gun, or war-club. The weapon here figured (fig. 1) was formerly owned and carried by the Sioux chief, Black Bull, then a distinguished personage in Sitting Bull's command. By him it was eventually presented as a valuable token of affection and confidence to a young Ojibwa named Mois-ko-ko′-nia ('Red Robe'), toward whom, in accordance with certain intertribal customs, he had previously assumed the relation of adopted father. This title, it should be observed, does not imply actual interchange of filial and paternal duties, but rather expresses the existence of a purely ideal phase of sentimental friendship on the part of the persons concerned. The recipient is now at the head of one of the seven chieftaincies of the Red Lake band of Ojibwas, living upon Red Lake reservation, in northern Minnesota; and he there disposed of the specimen to its present possessor, Mr. Jonathan Taylor, late sub-agent of the Red-Lakers. The weapon in question is undoubtedly, therefore, a genuine Dakota puk-gah-mah-gun. These implements in general are not only used as weapons of war, but are also carried in the hand in times of peace, as a sort of ornamental appurtenance — much as a cane is sported by the city exquisite.

FIG. 1.

The head (fig. 2), which is the essential part of this specimen, is wrought from a stone of a quartzose character. It is symmetrical in outline, has a smooth though unpolished surface, and resembles an egg in form. The two ends are shaped alike, however; and they are produced into obtuse points, which are cleverly adapted to deal a most effective crushing blow, upon the skull for instance. Midway between the points, the head is encircled with a groove about five-eighths of an inch broad, and deep enough to receive the slender hoop of wood by which the head is bound to the staff serving it as a handle. The measurements are as follows: greatest diameter of head, three inches and seven-eighths; least diameter of head, two inches and a quarter; circumference of head corresponding to least diameter, measured at the side of groove, six inches and a half.

The stiff, slender staff is thirty inches in length, and averages about three-quarters of an inch in diameter. It consists of a central stem of wood enveloped in a sheath of leather. A section of the central stem, obtained by splitting, appears to be prolonged beyond the staff proper, and, following the groove, to surround the head like a hoop, and extend about twelve inches down the opposite side of the staff; to which, as indicated by certain markings, it is firmly bound. The leathern sheath is simply a strip of hide, closely drawn about

FIG. 2.

the wood, and overhanded together with sinews in a longitudinal seam. The sheath is terminated at each extremity by a narrow strap: that at the foot of the staff is a mere ornamental appendage. It is perhaps an inch in width by three in length, and is adorned with a tassel of horse-hair attached to it by a leathern string. The upper thong is five-eighths of an inch wide, and encircles the head outside the wooden hoop, following the groove. The free extremity terminates in a long gore, which fits into a corresponding opening at top of sheath, on the side opposite the origin of the thong. It is secured in place by stitches of sinew. An ornamental row of brass-headed nails attaches this thong to the wooden hoop beneath. The straps are cut in one piece with the remainder of the sheath.

The grip, or lower half of the staff, is furnished with a second casing, formed from a belt of bead-work, manufactured of a proper width, and joined along its edges like the inner sheath. This belt is, for the most part, woven in narrow alternating stripes of green and of white beads. The top of the grip, however, consists of a broad band of white, upon which, done in green, figures an Indian, adorned with an eagle-plume, and holding in one hand something, perhaps, intended to simulate a tomahawk. The ribbon attachments shown in the plate have been added by the Ojibwas. Possibly the bead-work envelope may also have been contributed by the latter, as the Ojibwa women are most expert in the art of needle-weaving.

Ojibwa bone-breakers.

I am informed by Ojibwas[1] competent to speak in the matter, and also by other authorities, that an instrument corresponding in several particulars with the one above described was formerly commonly employed for domestic purposes among the Ojibwas. The latter implement is said to be actually in use at the present time, at isolated points where bands, or parts of bands, are yet living, practically, in the 'stone age.' The Ojibwa utensil is named a bone-breaker. It is a coarse implement, having a roundish form, without pointed extremities. It is furnished with a groove, like the Dakota specimen, and it is much the same with that weapon in general size. The stone head is attached to the handle by methods identical with those used in binding the head to the central stem of the puk-gah-mah-gun.

The head of the bone-breaker appears to be the counterpart of a small stone object described and figured by Dr. C. C. Abbott, in his 'Stone age in New Jersey' (see his fig. 312). At least, this figure has at different times been pointed out to me as a bone-breaker by intelligent elderly Ojibwas of Red Lake reservation, to whom, during a summer spent at their agency, I took occasion to exhibit certain of the plates in Dr. Abbott's book.

Very explicit and interesting statements concerning this implement were made by various persons, and particularly by the missionary in charge, Rev. Fred. Smith, an Ojibwa brought up as a 'blanket Indian,' in what is now central Minnesota. In his early youth, Mr. Smith had frequently seen the bone-breaker in service in the family lodge. He had occasionally met with implements of the sort elsewhere, though they have, of late years, fallen into general disuse; but he believed that such were still used by the Red-Lakers of the north shore who are remote from the agency. He had never known this utensil to be employed as a weapon, and thought Dr. Abbott's figure was undoubtedly a bone-breaker. It was used for breaking the bones of game when they could not be parted readily with a knife; as, for instance, in dividing the spoil of hunters, in cutting up meats for cooking, or in distributing food to one's family.

FRANC E. BABBITT.

THE CRUISE OF THE ALBATROSS, FROM CURACOA TO ASPINWALL, IN FEBRUARY AND MARCH.[1]

WE left Curaçoa at 7.20 A.M., on Feb. 18, and ran a line of soundings in a southerly direction to the mainland, the greatest depth found being 738 fathoms. The government and people of Curaçoa will watch with peculiar interest the result of this line of soundings, as it will go far towards solving the problem of procuring a much-needed supply of fresh water by sinking artesian wells.

The relation this island bears to the mainland has been heretofore unknown; the general impression being that it was an isolated volcanic peak, having no connection with the watershed of the contiguous coast of Venezuela. In this case, water would not be found by sinking artesian wells: on the other hand, if connected with the main by a plateau or neck of land

[1] Ojibwas, or Chippewas. The former term is that by which these people designate themselves: the latter is our corruption of that name.

[1] Abstract of the official report of Lieut.-Commander Z. L. TANNER, commanding, to Prof. S. F. BAIRD, U.S. fish-commissioner. Received through the courtesy of Professor Baird.

having a moderate depth of water over it, wells might be sunk with a fair probability of success. An effort was made recently, by the colonial government, to ascertain the depth of the channel, but without success.

During the afternoon we made a haul of the dredge in 122 fathoms, and of the trawl in 208 fathoms, in the channel above mentioned, with but moderate success. A few specimens were, however, secured from both hauls. The small amount of life on the bottom of the Caribbean, compared to that off the New-England coast, has been a constant surprise to me during the cruise.

At 1 A.M. the following day a course was made north-north-west for Alta Vela, a small island on the south coast of San Domingo. Soundings were taken at intervals of 10′, 20′, and 25′; and at 9.10 A.M. we sounded in latitude 13° 17′ 45″ north, longitude 70° 1′ west, with a depth of 1,701 fathoms, the bottom composed of foraminiferous ooze and coarse sand. The small beam-trawl was landed on deck, with a few sponges, shrimp, small fish, etc., indicating any thing but rich ground. On the morning of the 21st we passed a few miles to the westward of Alta Vela, and laid a course north-west for Cape Jacmel, sounding at intervals of about 16′.

The deepest water found between Curaçoa and San Domingo was 2,694 fathoms, in latitude 13° 40′ 20″ north, longitude 70° 10′ 45″ west. The bottom was brown ooze, without a trace of foraminifera. The average depth was about 2,300 fathoms until within a short distance of the land, when it shoaled rapidly to 302 fathoms four miles south-west of Alta Vela, deepening again to 2,410 fathoms 20′ west-north-west of the island; the next sounding, 16′ distant north-west by west, revealing 2,434 fathoms, — the greatest depth between Curaçoa and Aspinwall, with the single exception before mentioned.

The line was extended to Jacmel, showing bold water to the cape; then 60′ south, crossing a ridge which extends westward from Alta Vela. We then ran a line north-west 40′, crossing the line of the ridge above mentioned, but found it had terminated, or changed its direction, as we carried a uniform depth of about 2,400 fathoms. We then steamed 18′ west-south-west, and sounded in 2,490 fathoms, brown ooze, latitude 17° 39′ 30″ north, longitude 73° 22′ 15″ west; 'Leighton rock awash,' hydrographic-office chart No. 36, being located in latitude 17° 37′ north, longitude 73° 21′ west. After another run of 15′ north-west by west, we sounded in 2,369 fathoms, brown ooze, latitude 17° 48′ north, longitude 73° 34′ 15″ west; 'Loos shoal' being placed in latitude 17° 45′ north, longitude 73° 30′ west, hydrographic-office chart No. 36. These shoals were searched for in 1872 by H.M.S. Philomel and Plover, and, as they were unable to find them, they were expunged from the admiralty charts; but, being still shown on hydrographic-office charts, I considered it advisable to settle the matter beyond all dispute by ascertaining the actual depth in the localities assigned them.

Another sounding was taken 9′ south of Point Abaçou, in 1,039 fathoms, and then a line run 30′ west, sounding every 10′; then north-west 13′, and south-south-west 53′, sounding at intervals of about 15′ for the purpose of eliminating a large number of negative soundings appearing on the chart, and also to examine two shoals referred to in hydrographic-office publication No. 63, as follows: "More recent soundings of 16 fathoms have been reported in latitude 17° 45′ north, longitude 74° 39′ west, and also in latitude 17° 13′ north, longitude 74° 58′ west." We found 803 fathoms within three miles of the former position, and 1,120 fathoms on the position assigned to the latter, demonstrating conclusively that shoal-water does not exist in the positions named. It is highly probable, however, that much less water may be found west and north of this locality.

From our last position we ran 15′ north-north-west, and sounded in 968 fathoms; then changed the course to north by east for 70′, sounding at intervals of about 15′, except in one case, when a sounding of the Blake intervened. A reference to this line will show the bottom to be very uneven in this locality; and a depth of 262 fathoms in latitude 18° 18′ 30″ north, longitude 74° 53′ 30″ west, about 10′ south-east by east from Navassa, is something of a surprise. The water deepens to 1,040 fathoms 15′ to the northward and eastward of the island, and to 1,347 fathoms 8′ north-west of Cape Dame Marie. From this point we ran east by north 60′, sounding at intervals of 20′; the second cast giving us 1,974 fathoms, and the third, 342 fathoms, about 10′ to the westward of Gonave Island. From this point we steamed north by east 20′, where we found 800 fathoms, and 20′ west by south 502 fathoms, which was, of course, a surprise. From this point we ran a line west-north-west 76′, sounding at intervals of 20′. The maximum depth found in the windward passage was 1,923 fathoms.

At 12.40 P.M., Feb. 25, we sounded in 1,639

fathoms, green sand, latitude 19° 45′ north, longitude 75° 4′ west, took serial temperatures, and at 2.40 P.M. put the trawl over, veering to 2,400 fathoms, landing it on deck again at 6.55 P.M., having made a successful haul. There were a variety of sponges, some very large shrimp, one fish, numerous shells, small crabs, holothurians, and an interesting octopus, the arms all of the same length, and connected by a membrane. The color was cherry-red on its head, changing gradually darker towards the extremities.

Feb. 27, we stood out of the harbor of Santiago de Cuba, and made ten hauls of the tangles in search of Pentacrinus. Several hauls were made before we succeeded in getting a specimen: finally, however, we procured four fine ones in perfect condition.

We next ran a line south-south-east 93′, in the direction of Navassa, sounding at intervals of 10′ to 20′. The maximum depth, 2,275 fathoms, was found 44′ from Santiago de Cuba lighthouse, gradually decreasing to 870 fathoms about 6′ from Navassa, from which point we ran a line west 30′, sounding at intervals of 15′; the first cast giving 1,015 fathoms, and the second 620 fathoms, 7′ east from Formigas banks. A line was then run south-south-west 50′, sounding at intervals of about 12′. The greatest depth, 1,153 fathoms, was found midway between the banks and Morant Point, the last cast on this line giving 450 fathoms, 10′ east-south-east from the light, which was in full view. Having located the ship accurately with reference to the above-mentioned light, we started ahead at 4 A.M., running a line east-south-east, sounding at short intervals, towards a shoal marked as follows on hydrographic-office chart No. 35: 'Eight shoal.' We found 21 fathoms on the northern end of the shoal, east-south-east about 32′ from Morant-Point lighthouse, inlet 17° 44′ north, longitude 75° 50′ west. It is about 9′ in length north-north-east and south-south-west, and from 3′ to 4′ in width. The least water found was 17½ fathoms.

Leaving the southern edge of the bank, we ran a line west by north 58′, sounding at various intervals. The depth of water found, at the first cast south-east of an 18-fathom sounding on the edge of the bank, was 360 fathoms, increasing to 838 fathoms 3½′ to the westward; the greatest depth on the line, 875 fathoms, being reached 4′ farther to the westward, from 400 to 700 fathoms being found throughout the remainder of the line. Port-Royal light bore north-north-west 7′ distant, at the last sounding on the above line, which gave 484 fathoms. Another and the last cast before entering port gave 400 fathoms, 2′ north-west by north from the position above mentioned, and quite near the bank. Having passed quarantine, we went on to Kingston, where we anchored.

During our stay here, we had several dry days in succession, — an unusual occurrence since our arrival in the Caribbean. The naturalists were busily engaged in collecting while in port, and found it excellent ground, the best, in many respects, that we have found in the West Indies.

On the morning of the 11th of March, we again proceeded to sea. Arriving near the edge of the bank, we put the tangles over; but, unfortunately, they fouled on the coral bottom, and were lost. We then ran a line of soundings south 15′, sounding at varying intervals, crossing the centre of California bank in 26 fathoms. At 6.40 P.M. we sounded in 966 fathoms, sand, latitude 17° 36′ 10″ north, longitude 76° 46′ 5″ west, and put the trawl over, landing it on the bottom at 8.20, and on deck at 10 P.M., after a successful haul. One rather remarkable specimen was a large earthenware jar, with its surfaces pretty well covered with worm-tubes.

We steamed about 5′ to the north and east during the haul, and, starting from that point, ran a line directly to Morant Cays, east-south-east 42′, sounding at short intervals. At 11.45 A.M., March 12, anchored in 4 fathoms, under the lee of north-east Cay. At 8.35 P.M. we turned our head to the southward, and ran a line south by east about 140′, to a group of negative soundings, in the midst of which we cast the trawl in 2,295 fathoms. We then continued the line about south-south-east, in the direction of Santa Marta, and, finding no indications of shoal-water, passed about 12′ to the westward of Santa-Marta lighthouse, sounding at frequent intervals as we approached the coast; then stood off north-west 35′, sounding at intervals of 15′; then south for the mouth of the Magdalena River and Savanilla, anchoring off the latter place at 8.28 A.M., March 16.

The sounding-wire parted several times during the night of the 11th, and morning of the 12th, in a most unaccountable manner; losing either lead or sounding-rod, and a thermometer, with more or less wire each time. We were inclined to blame the splices at first, but soon found that we must look farther for the cause. In the mean time, we changed wheels, leaving the solution of the mystery until the following day, when, after reeling the wire off, the drum was found to be collapsed. The metal was neither broken nor cracked; but the centre simply

settled down on the bolts, the sides retaining their form. There would have been little or no harm arising from this; but the edges of the drum drew away from the sides, leaving sufficient space for a turn or two of wire, which became so firmly fixed in wheeling in, that it would part before clearing itself when sounding. This condition was caused, probably, by slack turns from time to time, when taking very deep soundings.

We were unable to examine the bar at the mouth of the Magdalena River because of the high winds.

The government of the republic and people of Barranquilla realize the necessity of providing a more practicable outlet for their great river; and, with this end in view, surveys have been made for a deep-water terminus of the Bolivar railway.

We left Savanilla at 8.15 A.M. on the 22d, and ran a line of soundings west 52′, to the position in which the U. S. S. Powhatan reported shoal-water, where we found 1,175 fathoms, the water having deepened regularly since leaving port. From this point we ran a line south 40′, and being then 16′ west by north from Cartagena lighthouse, in 825 fathoms, we stood offshore west-south-west 43′, then south-south-east 51′, to a point 7′ north-west of Fuerte Island, where we found 38 fathoms. Soundings were taken at intervals of 10′ to 15′ since leaving Savanilla: the change in depth was gradual, making it extremely improbable that shoals exist outside of the shore reefs. At 3.30 P.M. we started on a line west, sounding at intervals of 5′ to 20′, crossing the bay at the bottom of which lies the Gulf of Darien. At 4 P.M. we cast the trawl in 42 fathoms, green mud, latitude 9° 30′ 15″ north, longitude 76° 20′ 30″ west, and at 4.55 another haul was made in 155 fathoms, green mud, latitude 9° 30′ 45″ north, longitude 76° 25′ 30″ west, both hauls furnishing us with a small number of good specimens.

The line was continued, sounding at various intervals, to Aspinwall, where we arrived at 2.55 P.M., March 25. The strict quarantine observed in this port, because of suspected yellow-fever, will, of course, prevent our naturalists from making collections which I expected would be the most fruitful owing to the facility with which they could reach the interior by the railroad. The return home of Ensign A. A. Ackerman will restrict our investigations, as he has taken the branches of geology and mineralogy during the cruise.

We expect to sail to-morrow, April 2, running a line of soundings to Old Providence Island, thence to Cape San Antonio, and to arrive in Key West about the 14th instant. [See Notes for account of the next cruise.]

THE OLDER WIND-CHARTS OF THE NORTH ATLANTIC.

THE series of charts of the North Atlantic now in preparation at our hydrographic office, of which three monthly sheets are just issued, recalls the famous work of Lieut. Maury, thirty years ago, with which our approach to a precise knowledge of ocean meteorology began. Current-charts go back to 1678, when the first one for the Atlantic was published by Kircher,[1] and the general circulation of winds was roughly shown as long ago as in the map by Dampier,[2] of a little later date; but these, and all their successors down to comparatively recent years, were based only on general records, and not on the systematic apportionment of observations to definitely limited small areas of the ocean. The method of 'squaring' observations began with the English hydrographer, Rennell, about 1830, but was not then carried very far, and waited for its full expansion till taken up by the enthusiastic Maury. The remarkable series of charts published by him about 1850, for the Atlantic and Pacific Oceans, marks an epoch not only in our knowledge of the ocean, but in the progress of inductive meteorology; and the greater number of wind and current charts published since that time are taken very closely from his results.

The improvement in this kind of work during the past fifty years has been not only towards greater accuracy, as permitted by the increase in the number of observations, but also in the method of charting, in which the aim has been to reproduce in a compact form, as clearly and fully as possible, all the original records, so that the navigator may recognize not only the average of the conditions of air and sea that he is to encounter, but the separate elements from which the averages are derived. Maury evidently perceived the importance of thus exhibiting observations as nearly as possible in their separate forms, instead of in the inaccurate generalizations of his predecessors; and this led him to the construction of the most realistic charts of the ocean that have ever been published. Not only the winds and currents were plotted in their place of observation, but the track and name of the vessel from whose log they were taken were mapped also. A small part of one of the North Atlantic wind and current charts is here reproduced in fig. 1, omitting certain details concerning the strength of the winds, as well as the colors by which the seasons were distinguished. The full, broken, and dotted lines indicate months within the seasons. Nothing could be better adapted to emphasizing the reality of the work in the mind of the average sea-captain; and the result of the ingenious device was soon apparent in the general interest ex-

[1] Ath. Kircheri, Mundus subterraneus. Edit. tert. Amstelod., 1678, i. 134.

[2] Discourse on the trade-winds, in his Voyages. London 1705.

cited among seamen in the study of the physical geography of the sea. It was a time of awakening to an opportunity of observation that had been too

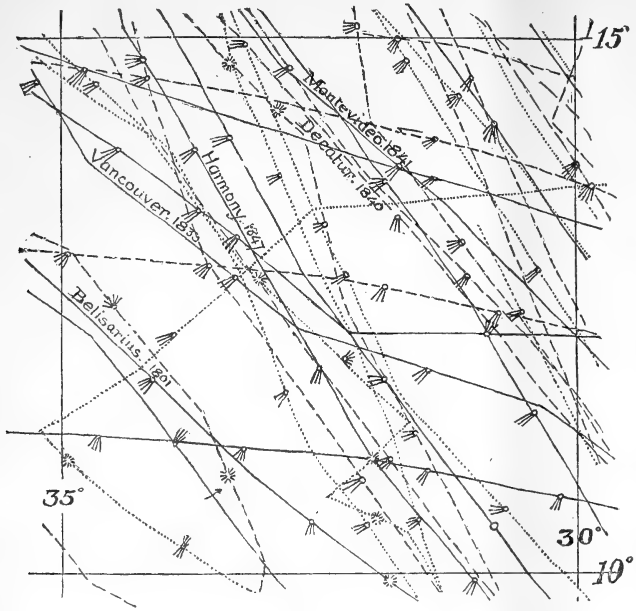


FIG. 1.

generally neglected before. But, in spite of their practical appearance, the Wind and current charts (or Track-charts, as they are commonly called) become unserviceable in the more frequented parts of the ocean, precisely where they are most needed, from the crowding together of observations. Along our coast and about the favorite longitudes for crossing the equator, the charts are unintelligible, except to the most painstaking examination, so completely are they covered over with a maze of signs and figures and a tangle of lines. This difficulty was overcome in the Pilot charts, on which the winds were singled out and counted for place and time; the style of record being shown in fig. 2. The numbers in the corners give the total number of wind-observations for each month in the given five-degree square; December, January, and February being in the northeast corner, and the others following in the order of hours on a clock-dial. The sixteen sectors of the circle include the number of times the wind was recorded for every month from the several compass-points to which they belong, the months being arranged as in the sector below the square. The centre contains the number of calms for every month in the same order as the total winds. The absence of graphic representation of the winds, and the confusion arising from the number of figures required to show the whole year's record on one sheet, were the chief disadvantages of these historic charts; but they were still vastly better than any thing of their time. Besides these, there were also prepared, about the same time, charts of the trade-winds and of the frequency of rain and storms. In the further development of the study, the treatment of the Atlantic winds will receive our chief attention.

About 1855 a series of charts, based directly on Maury's Pilot charts, was prepared, under the direction of Admiral Fitzroy, for the London board of trade, on which the numerical form of record was replaced by graphic wind-roses for five-degree squares. These are known as the Board of trade wind-charts.[1] A little later Admiral Fitzroy published charts for the North Atlantic, showing winds, currents, temperatures, etc., for five-degree squares for February, May, August, and November. These were based on logs obtained from the records of the Board of trade, as well as on Maury's charts. In 1868 the hydrographic office of the British admiralty published its 'Pilot charts for the Atlantic Ocean,' giving Maury's results, combined with those from all other attainable sources, presenting the whole in simple, graphic form, but without precise indication of the original observations on which the averages were based. These are commonly quoted as giving the best general view yet published of the physical conditions of the Atlantic as a whole. Four large sheets show the winds for the four seasons, with the so-called 'limits of the trades' for every month; but insufficient attention

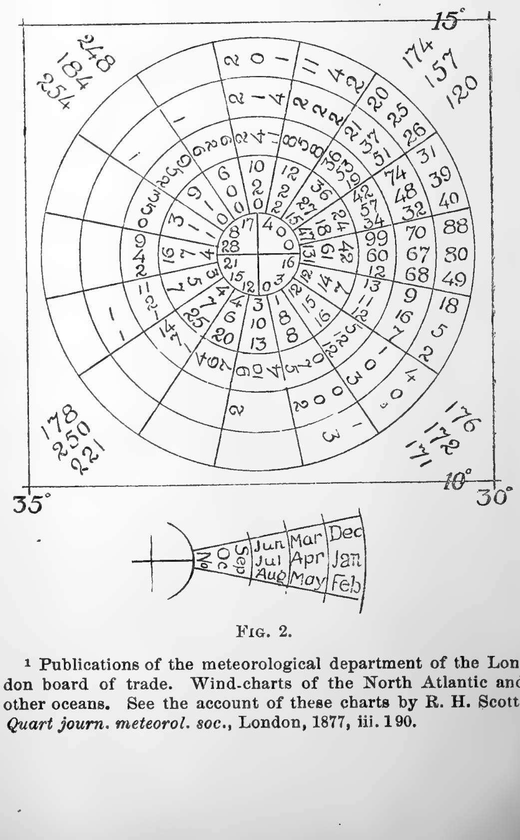


FIG. 2.

[1] Publications of the meteorological department of the London board of trade. Wind-charts of the North Atlantic and other oceans. See the account of these charts by R. H. Scott, *Quart journ. meteorol. soc.*, London, 1877, iii. 190.

was given to barometric and thermometric conditions. A fifth chart gives the average direction of the currents for the year.

Four years later (1872), these were given more extended form in the 'Wind and current charts for the Pacific, Atlantic, and Indian Oceans,' about on the same plan as before, but with the addition of isothermal and isobaric lines in small side charts, after the pattern of those prepared by Dove and Buchan. Part of the information in these charts was superseded, in 1872, by a volume giving monthly maps of 'Currents and surface-temperatures of the North Atlantic Ocean, from the equator to latitude 40° north,' prepared by R. Strachan, under the direction of R. H. Scott of the meteorological office. This is still the best work on North Atlantic currents and temperatures. The averages are here given for two-and-a-half-degree squares, from Maury's charts, Dutch observations, and some other sources, with the number of observations on which they are based. It is very evident from this, that the currents, especially, need a much more extended examination than they have yet received, especially when one recalls the irregular variations lately determined by Commander Bartlett in so marked a current as the Gulf Stream. If the currents have regularly periodic changes, as seems probable at certain places, the precise determination of their form will require a sifting of observations down even into one-degree squares.

The publications of the Dutch meteorological institute at Utrecht have long been famous. In addition to their extensions of part of Maury's charts in 1856,[1] a more independent set of monthly charts for the several oceans was issued a little later, on which a simple graphic method of showing direction and frequency of winds was adopted.[2]

Until recent years, comparatively little original work on the North Atlantic was done in France. The British pilot charts of 1868 were republished, changed only by translation of the names and explanations from English into French. In 1863, Ch. Ploix published his '*Vents et courants, routes générales*,' compiled from Maury's and other works. A revised edition of this was issued in 1874. Since then, Lieut. L. Brault, in charge of the meteorological service of the dépôt of charts and maps of the French marine, has undertaken extended studies of meteorology of the several oceans, based on twenty thousand selected logs ('*toute une montagne de papier*') of French vessels, dated between 1800 and 1870, and independent of the work of other nations. He states that the average accuracy of record is much better than in the logs used by Maury.[1] His first series of charts gives the probable direction and intensity of the winds for every three months in the North and South Atlantic, Indian, and Pacific Oceans,[2]—sixteen sheets in all. In addition, a second series of monthly charts for the four oceans was to be prepared, showing winds, currents, rain, fog, cloudiness, squalls, storms, etc.; but these, I believe, are not yet completed. The accompanying cut (fig. 3) shows the graphic method of illustration used by Brault. The number in the middle is the number of observation for the square concerned. The radial bars show by their length the relative frequency of winds from the points of the compass to which they are directed. The different marking in these bars shows the relative frequency

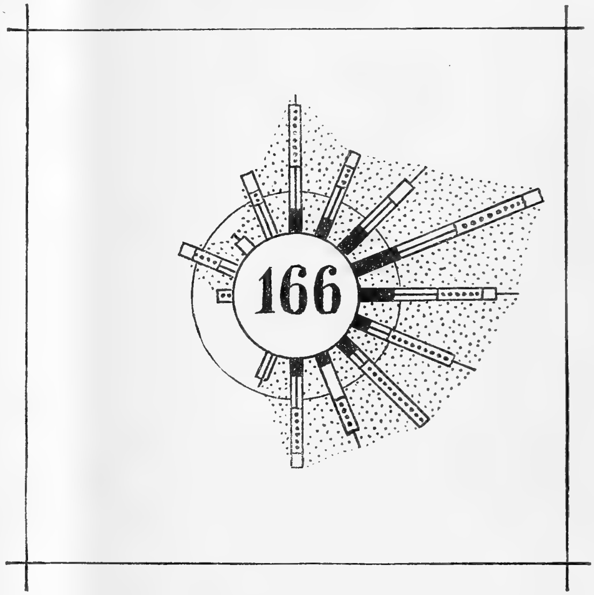


FIG. 3.

of five grades of strength, from heavy wind to light breeze. The ratio of the distance between the two concentric circles to the length of the longest arrow gives the percentage of calms. The detailed subdivision of winds according to their force is a special feature of this work. Brault notes that eighty observations in a five-degree square give trustworthy results for direction within the area of the trades; but three or four hundred are needed for the westerlies beyond the tropics. This statement is of value in enabling one to judge of the probable degree of precision in charts where the number of observations used in averaging is candidly given.

A valuable work, based on Portuguese and Dutch

[1] Maurij's wind-kaart voor het oostelijk gedeelte van den Noorder Atlantischen Oceaan, vermeerderd met hollandsche gegevens.

Maurij's passaat-kaart van den Atlantischen Oceaan, vermeerderd met hollandsche gegevens.

[2] 12 Windkaartjes van den Noorder Atlantischen Oceaan, etc. These were published in the *Uitkomsten van wetenschap en ervaring aangaande winden en zeestroomingen in sommige gedeelten van den oceaan.*

[1] *Étude sur la circulation atmosphérique dans l'Atlantique Nord pendant les saisons extrêmes.* Paris, 1879.

[2] *Cartes de la direction et de l'intensité probable des vents dans l'Atlantique Nord, pendant les mois de —;* 1874. *Id. dans l'Atlantique Sud;* 1876. *Id. dans la Mer des Indes;* 1879. *Id. dans l'Océan Pacifique;* 1880.

observations, covering a comparatively small but very interesting part of the ocean, is found in the account of the Gulf of Guinea by Lieut. Brito-Capello of the Portuguese navy.[1] The method of record here employed is easily understood, but does not give a measure of the number of observations used in averaging. Each fan is composed of arrows, showing the direction and velocity (estimated from distance made by sailing-vessels) of the local winds for a month. The angle of the fan measures the variability of the winds; and their length gives velocity, the distance between the cross-bars corresponding to the rather indefinite sailing-rate of 'one knot an hour close to the wind.' The apex of the fan is toward the source of the wind. The current-arrows show average direction, when the original observations accorded; but near the coast, where observations do not agree closely, averaging was not attempted. The length of the arrow is on a scale of one millimetre to two miles and four-tenths a day. Fig. 4 is from the chart for March and April; the fine-ribbed fans being for one month, the coarse-ribbed for the other.

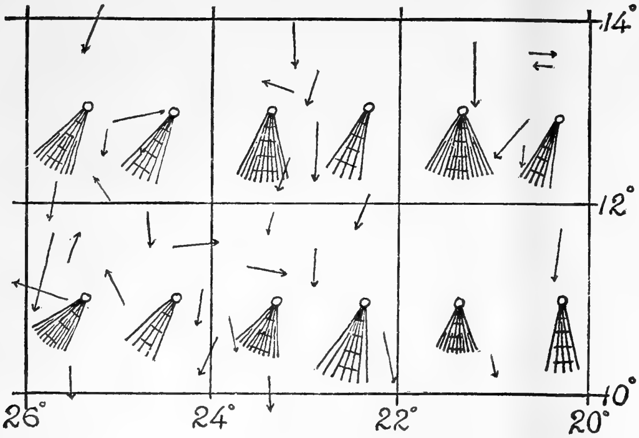


FIG. 4.

Three admirable monographs of a certain number of the ten-degree squares (ten degrees of longitude by ten degrees of latitude) into which the ocean is divided for the convenient partition of observations, have been prepared under the direction of Capt. Henry Toynbee of the British meteorological office,[2] from logs of British vessels collected mostly between 1855 and 1870. The equatorial squares from north latitude 20° to south latitude 10°, between Africa and South America, were first studied, as the doldrums of this region often cause vexatious delays to vessels crossing the line; and it is a problem of much importance to determine where the passage should be made. The group of squares about the Cape of Good Hope was next chosen as of difficult navigation, from their numerous gales and conflicting currents. These monographs are of the greatest value, not only to the seaman, but to the student as well; for they contain a large amount of information most carefully sorted out in time and place. Winds and isobars, temperature of air and water, currents, weather, clouds, etc., all have special record for ten subdivisions of every ten-degree square, and for every month. They are shown, first, in diagrams that summarize all available observations; and, second, most of these elements are given in charts of average monthly results. It is greatly to be hoped, both for practical and theoretical ends, that this excellent series of publications may be continued. Fig. 5 illustrates the concise method of detailed record of certain data for each of the ten subdivisions of the equatorial ten-degree squares. In the original, every thing relating to currents is printed in red. The number of observations and mean force (Beaufort scale) of winds are given numerically, for every point of the compass from which they blow, on the two inner circles, and are further marked by arrows, whose length shows relative frequency, crossed by a curved line,

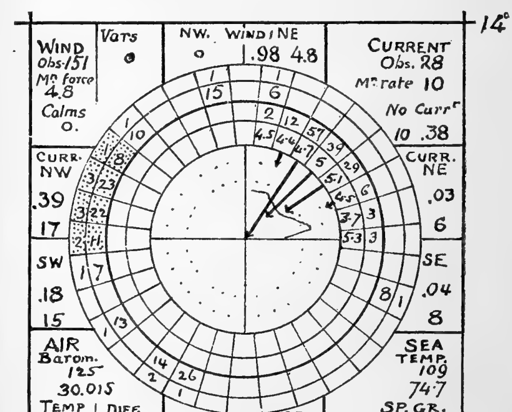


FIG. 5.

whose distance from the circumference shows force. Currents are plotted for the points of the compass toward which they flow in the two outer circles, the figures representing the number of observations and mean rate in miles per day. They are averaged for quadrants on either side of the circles; and an average of all currents is given in the upper right-hand corner of the square. Winds are similarly aver-

[1] Of this, I have only the French translation: *Guide pour l'usage des cartes des vents et des courants du Golfe de Guinée par M. de Brito-Capello.* Paris, 1862.

[2] Monthly charts of meteorological data for square 3; with remarks. London, 1874.

Monthly charts of meteorological data for the nine ten-degree squares of the Atlantic, which lie between 20° north and 10° south latitude, and extend from 10° to 40° west longitude; with remarks. London, 1876. (The results for square 3 are repeated in this second volume.)

Meteorological charts for the ocean district adjacent to the Cape of Good Hope; with a volume on the gales of that region. London, 1880.

aged at the top and bottom of the circles, and in the upper left-hand corner. The proportion of calms to winds is shown by the shading of a sector in the central circle (none noted in the square here copied). Number and average of barometer and air-thermometer observations are in the lower left-hand corner, with the average difference between dry and wet bulb thermometers. Temperature and specific gravity of the sea are similarly recorded on the right. The advantage of such record over final averages is at once apparent: it shows not only how well the various observations agree, but also the measure of trust to be placed in the results, as indicated by the number of observations. It is, of course, a little difficult to read at first, but, with a few days' practice, there is no further trouble. The charts for the Cape give less detail than those for the equatorial district, and their diagrams are of a much simpler pattern. Some of the more recent charts will be considered in a second article. W. M. DAVIS.

THE INDUSTRIAL ARTS AS FACTORS IN MODERN HISTORY.[1]

AT the outset the lecturer suggested, as perhaps a more appropriate title for his remarks, 'Coal as a factor in modern history,' or 'Coal as the great reformer and revolutionizer.'

By reviewing past history, it would be noticed that certain great events had taken place, each of which marked a step in the advance of civilization. The connection between these events was not always apparent; but in fact they were interdependent, and formed a logical sequence, in many cases one directly or indirectly causing the next. The ancient Greeks were famed for their literary and aesthetic culture, in which they excelled all other peoples, ancient or modern. Their passionate temperament, however, and system of slavery, left unlaid the material foundations of permanent national prosperity. Again: the genius of the Romans had displayed itself in their military achievements; and, doubtless, Rome would have continued to be the mistress of the world, had it not been for the luxurious and profligate habits into which her people drifted, and through which she fell an easy prey to the barbarians. So monstrous were their excesses, that their punishment was inevitable and overwhelming. The excellence which those nations had attained had, no doubt, benefited succeeding generations.

The secret of true and permanent progress consisted in the application of science to the useful arts; and the development of this fundamental principle of progress had commenced only during more recent years. This was the power that had revolutionized social and political life. No one revolution had effected thorough and permanent changes. By the instrumentality of each, the light of liberty had shone for a brief interval, but the intolerance which was put down by it had been too often succeeded by equal oppression on the part of those who had come into power. Yet each change had brought about a condition whereby the masses of the people had gained a greater or less advantage; and the power which each revolution had taken from the sovereign had been given to the people. These exchanges of power were more apparent in the history of England than of any country on the European continent. There the reign of every king had been despotic until the time of King John, when the Magna Charta was wrested from him, and thus was taken the first step towards the true liberty of the subject. Henry VIII., disregarding all laws, human and divine, had assumed as much despotism of action as was compatible with the then slowly advancing state of civilization. Elizabeth, too, was conspicuous for her assumption of unlimited power. Nor was Cromwell's power less supreme than that of the kings and queens before him. Then followed the court of Charles II., with all its splendor and vice. But soon after, when the house of Hanover flourished, a certain popular power began to undermine the autocracy of royalty. Then the Earl of Chatham, the elder Pitt, albeit with much individual pride and haughtiness, and with no special sympathy with democracy, became champion of the English people, and wielded a power which had never before been held by any subject of the crown. Pitt declared that he represented the people of England, and Wilke's resistance to the royal party again and again caused his election as a member of the House of Commons. The last attempt at despotic power, on the part of the reigning monarch, was the unjust taxation by George III. of England's American colonies. Since that time the power of the subject had been increasing in England, and at this day there was no country in which the rights of the individual were more fully recognized. The conservatism of the English nation had not permitted the dethronement of rank and title. This was, in the opinion of the lecturer, probably the result of inheritance, not choice. He said, moreover, that the distinction of rank held in check the power of money, and refinement and culture were thereby advanced; but, if the present monarch were to attempt to resume the despotism of some of her predecessors, a storm of revolution would sweep away monarch and throne and peers. For this changed and ameliorated condition of affairs, special credit was due to Sir Robert Peel, Cobden, John Bright, and Mr. Gladstone, the present premier. But the full triumph of democratic principles had not yet been fully realized in England, although it was rapidly approaching. It was worthy of note, that each Parliament introduced more liberal measures, and that the power of the House of Commons was fast superseding that of the House of Lords. England is now not only the home of freedom, but an asylum for the oppressed. Her shores are sought as places of refuge by fugitives of all kinds, who here found justice, and, if innocent, safety.

The moral and physical condition, too, of the present generation, is raised; and this age is conspicuous for its religious freedom, luxury, and the achieve-

[1] Abstract of a lecture delivered Saturday, April 19, in the U.S. national museum, Washington, D.C., by Prof. J. S. NEWBERRY of New York. Revised by the author.

ments of scientific investigation. We of this day scarcely realize that many things which are now considered necessaries of life were absolutely unknown a hundred years ago. These changes have been wrought by the action of cause and effect. How interesting was the inquiry into the causes of this peaceful revolution that had been and still was going on! Some historians had ascribed the changes to certain inherent qualities in man, which must develop as time rolls along. Others referred this progressive state to the continued effects of the Reformation, and considered it as the fruit of a purer and broader religious faith. The lecturer admitted that the emancipation of the mind from narrow dogmas had had its elevating influence, but denied that this would entirely account for the present condition of civilization. Since this age of freedom is also an age of scepticism, he contended that the most potent cause of the eminence of England, and of the spread of democracy, was the production of wealth through the industrial arts, — wealth created and controlled by the untitled classes, who thereby acquire self-respect, self-assertion, and political power. All historians had recognized this truth in part, but had stopped short of the conclusions, which, to the speaker's mind, every unprejudiced man must reach. The development of machinery and the useful arts constituted the most distinctive feature in the aspect of our modern life. This had created cities, provided occupation for the people, and was the means which had supplied the majority of our material wants. And the agent of this development was *coal*.

This conclusion might, perhaps, appear to be a *reductio ad absurdum*, but he thought that the truth of the assertion could be demonstrated. Coal supplied us with light, heat, and motive power, without which our condition would be one of darkness and inactivity. The wheels of industry would be stopped, and the characteristic activities of modern life would be arrested. In a pound of coal was stored sufficient force to raise 11,580,000 pounds one foot; and it had been estimated, that, on an average, 1,500,000 foot-pounds were utilized in the combustion of a pound of coal. Supposing this amount to be equal to the force exerted by one man in a day's labor, then three hundred pounds of coal were equal to the force exerted by one man in a whole year: in other words, a ton of coal yielded a force equal to the labor of six men and a boy for a year; and the force exerted by the average amount of coal produced in England in a year would be equivalent to the labor of two hundred millions of men for the same period. A moment's reflection would convince us of the immense effect produced by this force upon our modern civilization. If, out of the amount of coal annually raised from the English mines, 20,000,000 tons represented the net profit, it would be seen that this profit was equivalent to the labor of 133,000,000 people, working ten hours a day for a year. Was it, then, surprising, that, with such a revenue, England should be the richest nation on the globe, or the most prolific? She had planted colonies in those parts of the earth which were richest in agricultural and mineral resources; to wit, the United States, Canada, Australia, New Zealand, Cape of Good Hope, India, Jamaica, etc.: and these are fast becoming great nationalities. This marvellous success had by some been attributed to psychological rather than material causes; but the true cause, the speaker thought, was the development of machinery and the industrial arts consequent upon her abundant supply of coal. In the thirteenth century, when coal was first substituted for wood, and even a century later, its use was regarded as a nuisance, and actually forbidden by royal enactment, on account of the smoke which it evolved. Indeed, history told us that in 1257 Queen Anne, wife of Henry III., left Nottingham on account of the smoke caused by the burning of coal. By the middle of the sixteenth century, however, coal was in general use, and a considerable quantity was exported to France. In 1621 Dudley had devised a method whereby stone coal could be substituted for charcoal in the manufacture of iron. Then came gradually the introduction of steam-engines in place of horse-power, and iron rails instead of wooden ones, for the transportation of coal from the mines. The years 1702, 1776, 1815, and 1820 were conspicuous for improved changes in connection with steam-locomotion; and in the last-named year wrought-iron was substituted for cast-iron in the manufacture of rails. Fifty years ago Robert Stevenson perfected the locomotive, thus making the railroad the great pathway of traffic and travel. The lecturer then cited statistics which showed that the increase in the produce of iron and steel was proportional to the amount of coal produced. These were, he said, not only factors in the progress already noted, but were its proximate causes. It was worthy of note, that in those great English towns, such as Manchester, Liverpool, Leeds, and Newcastle, where coal was most largely used, the voice of the people was most powerful.

The lecturer then reviewed the possibilities for advancement in the United States, with its coal area of two hundred and fifty thousand square miles. He referred to the almost unlimited deposits of iron, copper, lead, and the precious metals, and to the vast wealth to be drawn from the soil by a thorough system of agriculture. Thus he argued that the United States possessed all the qualifications necessary to make it a greater and happier country than the world had ever seen. The great danger arising from these vast resources was the worship of the wealth they were destined to produce. The general accumulation of wealth by a nation was undoubtedly a blessing; but when held by the few, causing the impoverishment of the many, it could only be regarded as a curse. We might, however, hope, that when the evils of wealth-worship exceeded a certain limit, the people would again rise and correct them, as history teaches us they have done in the past. Among the influences which tended to restrict the effect of wealth on legislation, was the introduction of civil-service reform. The contest between labor and capital was far from adjustment; but the problem was under careful consideration, and in some instances had been practically wrought out to the satis-

faction of all immediately concerned, and to the instruction and guidance of others. The remedy for the excessive love of money would be found in the substitution of other and higher objects of ambition. This could not be expected at this stage of our nation's growth, but it would come with greater maturity. This age, he said, was the seed-time, and not the harvest; nor could the full corn appear until after the intermediate stages of the blade and ear.

THE PRESENT SUN-SPOT MAXIMUM.

AT p. 72 of the second volume of this journal, the observations of the solar spots, made during the previous six years by Professor Todd, now of Amherst college, were collated, and the inference drawn that the present maximum of spots had already passed at the middle of the year 1883. The remarkable solar outbursts, occurring at intervals throughout that year, and the continued manifestation of spot-activity during the present year, have led to renewed discussion of this subject abroad, where very different views are held by the leading authorities in solar physics. Dr. Wolf of Zurich inclines to the belief that we have not yet the data for determining accurately the epoch of maximum; much the highest *monthly* maximum having occurred in April, 1882, while the relative number expressing the spot-prevalence for the year 1883 is easily seen to be greater than that for the year previous. Faye thinks the maximum undoubtedly past, and regards the spottedness during 1883 as "just such secondary maxima as 'might well occur in the progress of a periodic phenomenon which passes rapidly and without hesitation from a minimum to the following maximum, but which passes gently by a series of secondary oscillations from the maximum to the following minimum,' as it is well known the solar spots do." Wolf states, that in 1882 there were no days without spots, while there were four such in 1883. Tacchini of Rome concludes, from the spot-observations of 1882 and 1883, that the solar activity has been on the increase during the latter year: "for, although the difference in the number of spots is very small, the number of groups in 1883 has been very much greater, and the extent of the spots has been truly extraordinary: it has been double that of 1882."

Dr. Spoerer of Potsdam calls attention to a question regarding the numbers, and positions on the solar surface, of the spots observed during the past thirty years. While it has long been recognized that the spots are most numerous, not at the solar equator, but in zones of solar latitude about 15° to 20°, Spoerer's discussion emphasizes the fact, "that, from the time of one minimum until the next, the region of greatest spot-frequency gradually drifts downward from the zone 30° to 25°, to the immediate neighborhood of the equator, and that about the time of maximum its seat lies about 17° or 18°. As the next minimum period is approached, spots more than 15° from the equator gradually become rarer than spots of 35° latitude and upwards were at the time of maximum. But directly the time of minimum is past, spots begin to appear again in those higher latitudes where but very few, perhaps not a single one, had been seen for several years." As justly remarked by the editor of the *Observatory*, this law of sudden transfer of spot-activity from one zone to another is one of the most striking revelations of solar research, and must be accounted for by that theory of spot-periodicity which would be accepted as satisfactory.

Regarding the determination of the present spot-maximum, the same writer observes, that the chief difficulty lies in a variety of opinion regarding what class of data is to be accepted as affording the true index of the state of solar activity. The unusual magnetic perturbations have occurred in coincidence with "the appearance or rapid development of some single spot or group of spots of abnormal extent," and not at the same time with the existence of great numbers of small spots. It would appear, thus, most likely that the total spot-area, rather than spot-numbers, should be taken as the true index.

GUYOT'S VIEW OF CREATION.

Creation; or the biblical cosmogony in the light of modern science. By ARNOLD GUYOT, LL.D. New York, *Scribner's Sons*, 1884. 16+139 p., 9 pl. 16°.

THE great eminence of Professor Guyot in several departments of science is a guaranty that what he writes is worthy of attention. The singular simplicity and clearness of his style make what he writes interesting. But, more than all, the earnestness, the truth-loving sincerity, and deep devoutness of the man, in all he wrote, or said, or did, take captive the reader, or hearer, or companion, and bear him along by the force of sympathy. There has been no teacher in this country who has inspired his classes with deeper personal love, or profounder reverence. To us who knew him well, his very presence was a benediction. It is hardly necessary to say, therefore, how deeply and sincerely we sympathize with the devout spirit which pervades this his latest book, and the noble aim of the author in publishing it. Surely, if we must have reconciliations of this kind between the geological record and the Mosaic cosmogony, this one is the noblest and the most rational which we have yet seen. If any one's declining faith still requires such *tonic*, we most cordially recommend this one; but it has long seemed to us that a *complete change of air* is the better, indeed the only, remedy. We believe that the time is rapidly approaching, if it has not already come, when the whole subject must be looked upon from a different and higher point of view. We have ourselves, in earlier years,

undertaken to make such schemes of reconciliation, and that which we finally and somewhat laboriously constructed was very similar to that of Professor Guyot. But latterly we have thrown all such aside, as belittling a transcendently great and serious subject. But for those who think differently, we give a very brief account of the book, with some reflections thereon.

Professor Guyot's scheme differs from many others in the fact that his first two days are wholly cosmic, and not terrestrial. First comes, of course, the creation of matter, its chaotic or nebulous condition, and the energizing of it by the brooding spirit. This is preparatory. Then, as the first day's work, is the creation of light. This, according to Guyot, was the condensation of the nebulous mass by gravity, and the consequent development of heat and light. The second day's work is the creation of the firmament, or *expanse*. The expanse here spoken of is the interplanetary space. This day, therefore, corresponds to the formation and separation of the planets (the earth among the number) from the still nebulous sun. The scene is now transferred to the earth, and the correspondence is henceforward with the geological record. The third day's work was the separation of land and water (by unequal contraction of the earth), and the creation of plants; at first, according to our author, only of the lowest kinds (protophytes). This corresponds to the early archaean. The fourth day's work was the placing in the heavens of sun, moon, and stars, for marking of days and nights, and times and seasons. This, according to our author, was the *first appearance* of the heavenly bodies by the clearing of the sky, heretofore completely obscured by clouds of vapor. This was a necessary preparation for animals and higher plants. It corresponds to later archaean. The work of the fifth day was the creation of animals (and our author thinks many higher plants also), monsters of the deep, creeping things, and fowl of the air. This corresponds to the whole paleozoic and mesozoic. The work of the sixth day was, first, the creation of four-footed beasts (mammals), and afterwards of man. This corresponds to the cenozoic or tertiary, and quaternary. The seventh day was rest, — no creative work, no new continents, no new organic forms. This corresponds to the psychozoic, or present. Throughout, of course, the days are regarded as cosmogonic, not solar days.

Such is a very brief sketch of the scheme. Those who wish to understand it more fully, and especially to see the skilful way in which the details are worked out, must read the book.

A few words now in the way of reflection and criticism. Professor Guyot draws special attention to the fact, that the word *bara* ('create') is used in connection with only three events; viz., the creation of matter, of sentient life (animals), and of spirit (man). In connection with other events, another word is used. He makes much of this in connection with the apparent chasm which exists between inorganic forces and life, and between the sentient soul (*anima*) of animals and the self-conscious spirit of man. Certainly there are great gaps at these points; but surely science would place the second one, not between plants and animals, but between plants and minerals. The *bara*, therefore, should come, not on the fifth day, but on the third.

Again: Professor Guyot assumes that life is an immaterial principle, not correlated with the other forces of nature as these are with each other, and connects this with the apparent impossibility of abiogenesis, or origin of life by inorganic forces; and this, again, with the necessity, as he thinks, of a rupture of the continuity of nature, and of a supernatural interference at the time of introduction of life on the surface of the earth. Now, as to the first point: we think that nearly all scientific men believe that life-force is derivable, and in fact is always derived, from physical and chemical forces, under appropriate conditions. One of these necessary conditions seems *now* to be the *previous existence* at the very place and time of *living* matter. Abiogenesis seems *now* to be impossible. Life is a necessary condition of derivation of life-force, but none the less is it derived from lower forces by transmutation.

This brings us to the second point. Most persons, even many scientific men, seem to think that the truth of the doctrine of evolution is conditioned on the occurrence, or at least the possibility, *now*, in this geological epoch, of abiogenesis. We do not think so: on the contrary, we think that the impossibility of abiogenesis *now* is exactly what a clear conception of the law of evolution would lead us to expect. The mistake which leads some to imagine that abiogenesis is a necessary corollary of evolution is of the same kind as that which leads some persons to imagine that evolution implies the capability of any one of the lower animals to develop into man. Golden opportunities in evolution occur *but once*. Birds, doubtless, came from reptiles; but this is not going on now. Reptiles came through amphibians from fishes, but a salmon may not

hope ever to change into a lizard. One of the greatest steps in evolution was the origin of life, but it is unreasonable to suppose that the concurrence of favorable conditions necessary for this step could occur only once in the history of the earth. The impossibility of abiogenesis *now* is, therefore, no argument against an abiogenesis once in the early history of the earth.

Again: the author, while he admits that evolution is not necessarily destructive of the idea of a guiding intelligence in nature, while he insists on the necessity of supernatural interference only at the three points mentioned above, thus implying that evolution may possibly take charge of the process in the intervening time, yet plainly inclines strongly to the supernatural origin of species. Along with many other deeply religious minds, he seems to shrink from the cordial recognition of the law of evolution as if it dispensed with the necessity of a God in nature. But surely this is no more true of evolution than of any other law of nature. If the law of gravitation did not destroy our belief in a divine sustainer of the cosmos, why should the law of evolution destroy our belief in a divine Creator? If the law of gravitation be nought else than the divine method of sustentation, then is the law of evolution naught else than the divine process of creation.

One thing more: the present epoch is supposed by the author to differ from all previous ones in the fact of *rest from creative work*. We cannot allow that this is the decision of science. The very possibility of a science of geology is conditioned on the continuance of geological changes, i.e., of creative work, under our eyes.

In conclusion, we must say, that, given the point of view, the frame of mind of the author, — a frame of mind still the most common among religious men, — the book is undoubtedly deserving of much praise as the very best of its kind. But we feel sure that the frame of mind of the religious world is on the eve of change, and, with the change, the '*raison d'être*' of the book will no longer exist.

TRYON'S CONCHOLOGY.

Structural and systematic conchology (etc.). By GEORGE W. TRYON, jun. Vol. iii. Philadelphia, *The author*, 1884. 453 p., 49 pl. 8°.

THE final volume of Mr. Tryon's work has appeared, including over four hundred and fifty pages of text and about fifty plates. It treats of the pulmonate gastropods, the Scaphopoda or Dentalia, the lamellibranchs, and the brachiopods, and contains an appendix with numerous additions and rectifications and an index of genera comprising nearly sixty-five hundred different names. We have previously referred to what we consider the defects of the plan and of some of the details of the earlier volumes, — defects which this one shares to a certain extent. Nevertheless, as it is in large part a treatise on groups which the author has made the subject of special study, he has made it by far the best of the three, — a fact which it gives us pleasure to recognize. In spite of the criticism which the work as a whole has seemed to us to call for, it is only fair to the author to point out the immense labor required to bring together the material condensed in the two descriptive volumes, and the service which this condensation, in spite of certain defects, will render to workers in conchology and paleontology. The devotion with which the author has applied himself to the study of mollusks for years, has not been fruitless; and here and there in the text most students will find scattered opinions and remarks which will recommend themselves as sound and judicious. While the character of the illustrations cannot be said to be satisfactory, yet they are in most cases sufficiently recognizable to be of service to him who knows what he seeks. If we fail to find in the systematic arrangement that grasp of the subject which might be wished for, and that exposition of recently developed truths one naturally seeks in the newest book, yet we recognize the benefit the author has conferred on specialists, at the cost of an enormous amount of drudgery, by bringing into reasonable orderliness, from innumerable scattered sources, the names and descriptions of thousands of generic forms. For this the work will be welcome in many libraries.

STEAM-ENGINE INDICATORS.

The Tabor steam-engine indicator. By GEORGE H. BARRUS, S.B. New York, 1884. 75 p. 24°.

THE preface of this little handbook states that it was prepared at the solicitation of the Ashcroft manufacturing company, makers of the Tabor indicator, as a book of reference and instruction to purchasers and others.

The subject of principal interest in the book is, of course, that of the construction and performance of the Tabor indicator, especially as compared with other indicators; although there is, besides this, a variety of useful matter, tables, etc.

With regard to this principal object of the book, we must confess to a little disappointment; for, since its author is an acknowledged expert in steam-engineering, we should naturally have expected him to institute experimental comparisons between this instrument and whatever other indicator is regarded as the best in market.

The improved form of the Thomson indicator, made by the American steam-gauge company, we believe to be in high favor with the profession. Mr. Barrus may, for aught we know, have compared the Tabor indicator with this or some other good modern indicator; but the only comparisons here published are with older instruments. The special mechanical advantage claimed for the Tabor indicator is the greater lightness of its moving parts. The pencil-arm (which has the highest velocity) is substantially the same in this and other instruments, and the reduction of weight is in parts having a less velocity. Still there is, we think, substantial truth in the claim of lightness. It would seem that any of these instruments might use aluminium to advantage to save weight in the moving parts.

From a curious little loop which is found just at the beginning of the stroke, after the admission-valve is opened, and which is not seen in the Richards and Thomson cards taken at the same time, we suspect that possibly the pencil lags behind its true position in other parts of the diagram, as it certainly must in some part of the loop, and that there are consequently unknown distortions of the card.

While great efforts have been put forth to make the parts carried by the spring light, and to give the spring as much firmness as possible, because its vibrations show with great distinctness upon the card, it does not appear that equal care and ingenuity have been expended to secure a positive to-and-fro motion of the card, which shall exactly correspond to the stroke of the piston. The exactness of this correspondence is of the first importance, but all errors of this nature are so masked in the indicator card as almost to defy detection. Since the typical steam-engine of to-day runs at a very high speed, and the indicator in its present form is essentially a low-speed instrument, the results which it gives are, to say the least, liable to uncertainties. For example: at speeds of six hundred to eight hundred revolutions per minute, the Tabor cards show vibrations which are probably as large as those in the Richards and Thomson at three hundred or four hundred revolutions per minute; and it appears as though no improvements could make any indicator of such a form work well at the highest speeds.

It seems possible, however, that a recent improvement in a new direction, made by Prof. J. Burkitt Webb of Cornell university, may overcome this difficulty;[1] and, as any improvement in instruments of precision is of importance to science, we may here briefly explain its nature. Were a pin so placed as to block the piston of the indicator just as it reached its highest point, it is obvious that the vibrations which then usually appear would be stopped; and, were another pin so placed that the piston could return only a small fraction of the whole distance to the zero line, then the pencil would describe only that part of the diagram between two lines near together, and parallel to the zero line. If during the next stroke these stops be moved one step nearer the zero line, the pencil will then describe another part of the diagram; and the process may go on until the diagram is completed. Since vibration is completely destroyed by this device, Professor Webb is enabled to use long and flexible springs, instead of the short, thick ones now in vogue, and so discard the parallel motion entirely.

[1] See figure and brief description in the *Trans. Amer. soc. mech. eng.*, 1883, reprinted in *Cotton, wool, and iron*, Feb. 2, 1884.

RECENT WORKS ON THE MICRO-CHEMISTRY OF PLANTS.

Vegetable histology. By D. P. PENHALLOW. Boston, *Cassino*, 1882. 40 p. 8°.

Botanical micro-chemistry: an introduction to the study of vegetable histology. By V. A. POULSEN. Translated with the assistance of the author, and considerably enlarged, by WILLIAM TRELEASE. Boston, *Cassino*, 1884. 118 p. 8°.

Hilfsbuch zur ausfuhrung mikroskopischer untersuchungen im botanischen laboratorium. Von WILHELM BEHRENS. Braunschweig, *Schwetschke*, 1883. 398 p., 127 figs. 8°.

A TRANSLATION of Schacht's little treatise on the microscope as applied to vegetable physiology, now out of date and out of print, has long been the only handy book in English, available to our students of histology who are unfamiliar with French and German. To be sure, all the better works on microscopic manipulation devote a few well-considered pages to directions for the manipulation of vegetable sections and to the principal reagents. But a convenient special work has long been felt to be a desideratum, especially in this country, where the exchange of microscopic specimens, and the interchange of hints by systematized correspondence, have never received the full

development which the utility of the exchange system warrants. Partly to meet this want of a handy guide for his own students, Professor Penhallow, now of McGill college, Montreal, prepared a work under the somewhat misleading title, 'Vegetable histology.' This little treatise deals only indirectly with histology. Its real design is to furnish a student, whether working alone or under guidance, with suggestions as to the use of the principal media in which to examine objects, the reagents for detecting the more common contents of cells and for recognizing the chief modifications which the cell-wall undergoes. In this it succeeds. The directions are clear, and sufficiently full to satisfy any beginner.

To meet the same demand among students in his own country, Poulsen of Denmark has published a handbook, which has been received with marked favor. The translations into German and French are widely known as useful laboratory guides. The recent translation into English, by Professor Trelease, has been neatly and carefully done, and embodies various suggestions by the translator, most of which are improvements. The work treats first of the reagents, their preparation, impurities, and employment. To this part is added a useful chapter on the media for mounting, and the safest cements. The directions for using the newer staining-agents are not always so explicit as to leave no room for further questions on the part of the student who is working by himself, but they are full enough to indicate the wide applicability of this group of chemicals. It is interesting to note how important a part staining-processes — which, within the memory of some of us, were wholly relegated to amateurs who desired to make pretty specimens for the sake of exhibiting their skill in manipulation — now play in the most recondite researches as to the behavior of the nucleus, and the growth of the cell-wall. It is doubtful whether these methods are not capable of much wider development.

Part second of Poulsen's book is devoted to the examination of vegetable substances. The author has included in his work upon this, some substances which might as well have been left out as some which do not find a place; but, as will be seen by a glance at the comprehensive treatises of Ebermeyer and of Husemann and Hilger, the task of selection is not an easy one. Professor Trelease has placed American teachers under obligations by the excellent translation which he has given them.

With a much wider scope, but covering within its range the materials made use of both by Penhallow and by Poulsen, Behrens's work upon the microscope and its use in laboratories of vegetable physiology, is a welcome addition to botanical literature. It is rather fussy in some of its particularities, but even this extreme of minuteness will be useful to many people into whose hands it is likely to fall. The *naïve* honesty of the author is well shown in some of the striking cuts: for instance, a couple of finished slides are delineated with cover-glass and cement and labels all in place; but the cement, instead of being laid on as evenly as an engraver would naturally depict it, has been represented with a charming and comforting irregularity which will be sure to be followed. In this work Behrens has given exhaustive details as to the selection and employment of all the appliances required in the histological laboratory, and has, for the most part, expressed his critical views with clearness and decision. The references to the literature of the subject are very copious. It is to be earnestly hoped that the announcement is true that the book is soon to be translated into English by a competent person, who has evinced much enthusiasm in microscopical matters. In such a translation it might be well to incorporate a part of the material which was intrusted to the more ephemeral microscopical journals, and which, useful at the time, is in danger of being lost. And such a translation would, doubtless, give less prominence to a few of the excerpts which Behrens himself has made from such journals.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Work in West Virginia. — The wisdom of the general government in lending its aid to the development of the wealth and natural resources of the country is nowhere, perhaps, better illustrated than in the work being carried on by the survey in that portion of the Alleghany coal-field that lies between the Great Kanawha and Chattarawha (or Big Sandy) Rivers in West Virginia. Topographical work in this section has been in charge of Mr. W. A. Shumway.

The necessity of preliminary topographical work needs no proof; for it is a self-evident proposition, that without the aid of correct maps, defining the mountains and ridges within which are embraced the main geological features of the country, the geologist, however well versed he may be, is likely to be led into error. The more complicated the geological structure, the greater the degree of accuracy required in the geographical work.

A glance at any of the existing maps of the United States will show that this southern part of West Virginia is about as destitute of railroad communication as any other district of the same area east of the Mississippi River, if not more so.

The peculiar topography of the Appalachians caused engineers to look suspiciously on attempts to cross its ridges at right angles to the axes of uplift, and for a long time retarded the development of this region. Thus unprovided with transportation facilities, the country itself was naturally but sparsely populated, and of itself unable to construct the means of communication with the great tides of commerce passing to the north and south. Another factor retarding the development of the region has its origin in the vexatious litigations concerning titles and the ownership of West-Virginia lands, which are due largely to the indefiniteness of former survey-lines, run independently and without connection with each other. This state of affairs will, in large part, be remedied by the work of the geological survey.

The completion of the Baltimore and Ohio, and the Chesapeake and Ohio railroads demonstrated the possibility of practical and feasible routes through the supposed barrier of the Alleghanies, and has partially developed one of the most valuable coal areas within the limits of the United States. It now remains to construct lateral branches, and to make a comprehensive and detailed geological investigation of what promises to be one of the most interesting mining and manufacturing regions of the country. Mr. Shumway, in 1883, surveyed between four thousand and five thousand square miles of this section, comprising the counties of Wayne, Boone, Logan, Wyoming, Mercer, Raleigh, Lincoln, and portions of Cabell, Fayette, Kanawha, and Summers. The office of the completed map is to supply the geodetic features for the establishment of the true position of the geological formations, and to serve as a basis for a subsequent elaborate and exhaustive geological study of the included region. Like all the older states settled previous to the adoption by the government of the present rectilinear surveys, West Virginia has been forced to rely, for her geological mapping, upon such field-work as very meagre state appropriations allowed. The work accomplished was consequently of a very fugitive nature; and, because of the absence of any connected system of land-surveys over the state, the existing published maps have no claim to faithfulness in the delineation of the geographical features of the country, much less to accuracy in the portrayal of the surface configuration.

It is true that innumerable land-traverses cross and recross the country in a perfect network of lines, some being run with more or less respectful regard to nature, but the greater number being surveyed by engineers solely in the interests of the land-owners. In the few instances which have a plausible claim to accuracy, the variations of the magnetic meridian, differing by no inconsiderable amount in contiguous tracts of land, and resulting often from the presence of iron oxide beneath the surface, precludes the possibility of accepting these disjointed meanders as furnishing reliable and correct geographical data for use as a basis for scientific work.

The difficulties met with in mapping the area under consideration are those common to the work in the southern Appalachian Mountains, where dense forests, and the absence of a sufficient number of commanding points well situated for triangulation stations, offer obstacles to the topographer which make the most constant demand on his experience and judgment, and, at the same time, call for the most extravagant outlay from his stock of patience and good nature. It is doubtful if, within the limits of the United States, there exists another section of country in geological structure so simple, yet for topographical work so replete with obstacles and difficulties, as this coal-region of West Virginia. It is simply bestowing credit where it rightfully belongs, to state that the forthcoming map is mainly the result of the experience and able judgment, in geographical work, of Mr. Henry Gannett, the chief geographer of the survey, who supervised the work in this area.

The character of the topography here, as in all regions, is derived from, and varies with, the nature of the geologic formations. The most casual study of the stratigraphy of the district evidences the fact that the entire country, now underlain by the coal-formation, at one time constituted a vast basin or geosynclinal. After a long period of oscillations, producing a series of emergences and submergences, during which the succession of coal-beds and interstratified sands, clays, etc., were formed, at or near the close of paleozoic time, there occurred an epoch of disturbance which resulted in the general elevation of the Appalachian region, and produced the numerous ridges, faults, and displacements of the Alleghanies. As might naturally be inferred, the greater the distance from the centre of disturbance, the less prominent were the effects, until reaching the axial line of the Flat-Top and White-Oak Mountains. We find that from here, westward to the Ohio River, the entire country seems to have been elevated in one mass, hinging on that river, and having a gradual slope to the north-west, which is the direction of the prevailing dip. The development of faults relieved in a large measure the strata lying to the westward; and the presence of the massive sandstone in the conglomerate series, also, no doubt, aided in preventing the flexures extending to the west.

This region may therefore be regarded as an eroded plateau, sloping from the east toward the Ohio: so that, to the west of the axial line just referred to, the rocks dip faster than the plane of erosion, and we pass necessarily into higher and higher strata of the coal-formation; that is, the highest strata in geo-

logical position occupy the lowest place geographically. The general plane of the country is determined by the upper surface of the conglomerate series, which continues to rise from the west, until, in the mountains already mentioned, it attains an elevation ranging between thirty-two hundred and thirty-five hundred feet. The Raleigh plateau-region owes its existence to the presence of the conglomerate series.

The comparatively incoherent strata of the carboniferous above the conglomerate sandstones were quickly eroded away. When the upper surface of the hard conglomerates was reached, the degradation of the surface in a measure ceased, and the mechanical action of the streams was concentrated in deepening and widening their channels. This has produced the cañon-like features so characteristic of the New-River district.

The lateral wear in most cases was necessarily slight. The marshes of Coal River form, however, a singular exception to the general topographical features; as in this case the erosion, acting laterally, has resulted in a deep and rather broad valley. The conglomerate series, with its slope to the north-west, passes beneath the lower coal-measures near the embouchure of Gauley River, which, in turn, sink beneath the water-level a short distance west of Charlestown. The lower barrens, which overlie them still farther west, pass beneath the upper coal-measures.

The cañon-like features of the valleys are gradually lost as we go westward from the Kanawha Falls; and the hills become lower and lower, until, when the Ohio is reached, they do not rise more than two hundred feet above the river.

With the exception of the gradual difference in elevation due to the general rise in the country from the Ohio eastward, the surrounding knobs appear on one and the same level, and offer the most indisputable evidence of the plateau nature of the entire country; the mountains being simply the uneroded remnants of higher strata, resting on the basal plane of the conglomerate series.

It is this character of the country, in which there are few salient points well located for suitable stations for instrumental work, that retards topographical work, and renders impracticable the application of methods that are elsewhere best adapted to effect the most economic and accurate results.

The primary triangulation extending over this section connects at the north and south with the triangulation work of the U. S. coast and geodetic survey, while the lines of the secondary work establish geographical positions throughout the entire area included between the Kanawha and Chattarawha Rivers. With these numerous geodetically determined positions, it was found possible, by judicious adjustment, to utilize a large amount of existing material, sufficiently accurate in point of drainage detail, but heretofore valueless as a means of absolute location.

The completed map, as prepared for publication, will be upon a scale of 1: 250,000, or approximately four miles to one inch, in approximate contour lines having a vertical interval of two hundred feet. When draughted, and made continuous with the government surveys extending throughout the whole southern Appalachian region, it will serve as a basis for subsequent geologic investigation in the field.

The field of work included in these surveys has long since been recognized as a most important one; and nowhere more than in the coal-measures of West Virginia is there a greater need for most concise and accurate geological and geographical knowledge, for nowhere can be found circumstances so favorable for the advantageous employment of capital.

Geological survey of Canada.

New-Brunswick division. — Work in this province will be resumed in May, under the direction of Prof. L. W. Bailey, and will be carried on in portions of Carleton and Victoria counties with a view to the preparation of an additional sheet of the general geological map of the province, of which about eight sheets have been already issued. A series of observations on the superficial geology will be simultaneously but independently undertaken by Mr. R. Chalmers.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston society of natural history.

May 7. — Mr. F. W. Putnam spoke of an interesting find by Dr. C. C. Abbott, who has made such important discoveries in the Trenton gravels of the Delaware-river valley, and who was the first to prove that man existed on the eastern coast of America at the time a large part of the country was covered with ice, or during the glacial period. The recent discovery was that of a portion of the right side of a human under jaw, which was found sixteen feet below the surface, in the gravel at the railroad cut near the Trenton (New Jersey) depot. In this same deposit, and a few feet above the jaw, Dr. Abbott had previously found a human tooth, and many stone implements of a rude type. The fragment of human jaw was exhibited, and is shown to be worn and ground in the same way as the pebbles above and about it. Mr. Putnam was on the spot a few days after the jaw had been discovered (on April 18) by Dr. Abbott, and identified the gravel and sand matrix in which the jaw is enclosed, with the material in place. Near and in the gravel above this jaw was found, a few years since, the tusk of a mastodon.

Anthropological society, Washington.

May 6. — Mr. O. Dorsey gave a classification of the Siouan tribes, including the Sioux proper, Assine-

boin, Ponka, Omaha, Osages, Kansas, Kwapas, Iowas, Otos, Missouris, Winnebagos, Mandans, Minnetarees, Crows, and Tulets. The general impression seems to have been, that this stock moved from the north-west. Mr. Dorsey took an opposing view, and traced the tribes from the south-east, up the streams, and from the region of the lakes westward. —— President Gallaudet said that there were in existence in Europe several societies whose object is to discuss the subject of international relations. The speaker took the ground that the proper basis of these relations should be ethical rather than legal. The law term for *jus gentium* was objected to, and the phrase, 'international rights,' or 'international ethics,' suggested. While nations would not listen to absolute commands of law, they have ever shown some willingness to listen to ethical arguments, on the justification of their foulest acts, by appealing to the verdict of humanity as to the justice of their cause. If publicists should insist that no acts of nations should be justified that are not right between individuals, the subject of international law would be settled on a firm basis, and Mirabeau's words, 'Le droit est le souverain du monde,' would become a fact. The paper was discussed by Major Powell, who took issue with the speaker on some of his means, agreeing with him in the desirability of the end to be attained.

Engineers' club, Philadelphia.

May 3.—Mr. S. N. Stewart exhibited a model of his river or current motor. Paddles are placed upon cranks, and maintained in a vertical position, by long, floating vanes or tails. The cranks are placed upon posts, rafts, or boats in the stream, and journalled at the water-line, thus keeping one-half of the paddle-surface in action, while the common floating-wheel, or current-wheel, only keeps one-tenth of its surface in action. In Mr. Stewart's motor, a ten-foot arm carries a paddle ten feet high. —— Mr. Thomas M. Cleemann read a paper on an economical form of bridge-truss. In outline, it resembles Whipple's arch-truss, inverted so as to bring the curved portion in tension, but differing from it in having the chord made to resist tension, and being anchored to the abutments. In this way, the only parts of the bridge in compression are the vertical posts, and the extra material required to stiffen the upper chord in an ordinary bridge is saved. To illustrate the correctness of his conclusions, Mr. Cleemann had a small model made of pink wrapping-twine, that broke with five and a half pounds, and with posts made of wooden knitting-needles. This model, by calculation, ought to have borne about eleven pounds. After loading it with a pound weight at each of the seven panel points, and letting it remain for a little time for the inspection of the members, he added, first, two more pounds at the centre, and afterwards two pounds more. With this eleven pounds, the model hesitated a moment, and then broke at each abutment, nicely illustrating the author's conclusions. He likewise gave the saving of material in such a bridge over a Pratt truss, of five hundred and sixteen feet span, and pointed out its advantages for military purposes, where facility of transportation is a prime object, and a bridge almost entirely of rope is especially valuable on this account. —— The secretary exhibited for Mr. J. H. Harden a neat topographical model of the Jones iron-ore mine in Berks county, Penn., and briefly explained the method by which such models are constructed.

Numismatic and antiquarian society, Philadelphia.

May. 1.—Mr. E. F. im Thurn of Demerara presented valuable works by himself, relative to the ethnology, geography, and fauna and flora, of British Guiana. —— A letter was read from Rev. Damaro Sota, mayor of San Sebastian, Concordia, state of Sinaloa, Mexico, in reference to his late discovery of the key to the Mexican hieratic writing, stating that he was preparing a work setting forth his views and the exact nature of his discovery. —— Dr. C. C. Abbott of Trenton read a paper on the existence of an early race in the valley of the Delaware, whose relics were found by him in the Trenton gravels, and adverted to a fragment of a human skull being found there by him on April 18, 1884, in connection with the palaecystic implements. At the conclusion of his address, he presented the society with a quantity of these hitherto debatable implements, which were plainly productions of the hand of man.

Academy of natural sciences, Philadelphia.

April 22.—Dr. Joseph Leidy directed attention to some fossils, part of a collection recently referred to him by the Smithsonian institution for examination. They consist, for the most part, of remains of large terrestrial mammals, especially related to forms which now live in the intertropical portions of the old world. Obtained in Florida, they are of additional interest as evidences of the existence, in this region, of a formation of tertiary age not previously known. An accompanying letter from Dr. J. C. Neal of Archer, Fla., states that the fossils were discovered in a bed of clay occupying a ridge in the pine-forest. They occurred over an irregular area of a hundred feet long by thirty feet wide, and were dug from variable depths of seven feet to the bed-rock, the character of which is not stated. The fossils, consisting of bones and a few teeth, are mostly in fragments, but exhibit no appearance of being water-worn, or abraded by friction among gravel. The collection embraces the remains of a young mastodon, consisting of bone fragments and detached epiphyses, with a vertebra of a teleost fish embedded in the clay adherent to the under surface of the head of a femur; the remains of several individuals of a species of rhinoceros rather smaller than, although quite as robust as, the Indian form; small fragments of the maxillae of a tapir; the remains of a llama as large as the camel; a calcaneum of a ruminant, not quite so long as that of the Irish elk, but of more robust proportions; the vertebral centrum of a small crocodile; and the remains of several other undetermined animals. The fragments were not sufficiently charac-

teristic to permit of their being placed specifically. The formation represented belongs to the pliocene or later miocene, although its exact position is somewhat uncertain. The tapir had been found in several states; and the mastodon was, of course, widely distributed; but neither the rhinoceros nor the camel-like remains represented in the collection had before been found east of the Mississippi. Professor Heilprin regarded the discovery of importance as lending decided support to Professor Hilgard's views regarding the former distribution of land in the region of the Gulf of Mexico, and the probable connection of Florida with Mexico. Similar fossils had, he believed, been found in the Mexican plains. The bed-rock near Archer, Fla., belongs to the oligocene formation. —— Mr. Joseph Willcox announced that he had again found in Florida, specimens of Nummulites Willcoxi Heil., which had been regarded as of so much interest when collected by him a year ago. The examples now submitted for inspection had been obtained about fifteen miles north-east of the original locality on Cheeshowiska River, and about a hundred and fifty feet above the sea. Professor Heilprin commented on the importance of the discovery of the more elevated region just reported as indicating where the nummulitic formation could actually be seen. The other specimens were collected not more than two feet above tide-water, and were not, therefore, absolutely indicative of the position of the parent rock. From association with the Orbitolites, we can state that the beds belong to the upper oligocene age. The genera Nummulina, Orbitoides, Heterostegina, Quinqueloculina, Triloculina, and perhaps Biloculina, together with Spirorbulina, were represented in the masses of rock received from Mr. Willcox. The remains of fresh-water mollusks were associated with them, specimens of microscopic Paludina having been determined. This association of fresh-water with marine organisms might indicate the former emptying of a river into the sea, or the presence of fresh-water swamps in ancient Florida. The elevation of the locality whence the fossils were obtained need not be regarded as complicating the problem; for it must be remembered that this in no way represents the original height of the formations.

Philosophical society, Washington.

March 29. — Dr. J. S. Billings spoke of the uncertainty of measurements of cranial capacity. The best results, without the division of the skull, are obtained by means of shot, which is poured in, and afterwards measured; but even these are poor. The same observer does not obtain closely approximate results from successive measurements of the same skull, and different observers obtain widely different results. He then exhibited a series of composite photographs of skulls, each photograph being derived from a series of adult male skulls of one race. In the formation of each negative, the plate was exposed successively to from seven to eighteen skulls. —— Prof. G. Brown Goode spoke on fisheries exhibitions, describing especially the international exhibitions at Berlin (1880) and London (1883). —— Mr. M. H. Doolittle began a communication, which was completed at the following meeting.

April 12. — Mr. M. H. Doolittle completed his communication on music and the chemical elements. The mathematical theory of music requires the satisfaction of the equation $2^x = \frac{3}{2}^y$ nearly, in which, for equal temperament, $x =$ the number of equal intervals in the octave, and $y =$ the number of these intervals that correspond to a nearly perfect fifth; and, for untempered music, $x =$ the number of approximately equal intervals in the octave, and $y =$ the number corresponding to a perfect fifth. This equation gives $\frac{x}{y} = \frac{\log \frac{3}{2}}{\log 2}$ nearly, $= \frac{176091}{301030}$ nearly; and, by the method of continued fractions, we obtain the succession of approximations, $\frac{3}{5}$, $\frac{7}{12}$, $\frac{24}{41}$, $\frac{31}{53}$, etc. For scales appropriate to major thirds, but disregarding fifths, we may substitute $\frac{5}{4}$ for $\frac{3}{2}$ in the above equations, and obtain the approximations, $\frac{1}{3}$, $\frac{9}{28}$, $\frac{19}{59}$, etc. For the chord having the vibration ratio 7:4 we may obtain in like manner the approximations, $\frac{4}{5}$, $\frac{21}{26}$, etc. The fraction $\frac{7}{12}$, belonging to the first series, is the base of the chromatic scale, and, less directly, of the diatonic. The fractions $\frac{3}{5}$ and $\frac{4}{5}$, of the first and third series, probably represent all the five-toned scales of primitive music. Pentatonic, chromatic, and diatonic scales have thus a mathematical basis, and are in a proper sense natural. There is reason to believe that simple mathematical principles underlie the phenomena of chemistry, and that the quantitative relations of the elements are expressible in the derivatives of small prime numbers. There is, therefore, no *a priori* absurdity in looking for a correspondence of musical and chemical ratios. If the keys of a piano be arranged with seven consecutive keys in a line, the next seven in the next line, and so on, the columns give successions of musical fifths. It has been shown, that when the chemical elements are arranged in the order of their atomic weights, in lines of seven, the columns contain elements remarkably similar to each other. If the piano-keys be arranged in lines of twelve, the columns give octaves; but nothing is developed from a similar arrangement of the chemical elements. The general conclusion was reached, that there is no deep significance in the coincidence of the number seven in the diatonic scale and in the chemical groups. —— Mr. Henry Farquhar then reviewed the theoretical discussion in Professor Tait's article on mechanics, in the Encyclopaedia Britannica, dissenting from several of his positions.

NOTES AND NEWS.

THE 'circulars' of Johns Hopkins university now appear so frequently, and with such varied and valuable contents, that they may already be looked upon as among the most important contributions to learning in our country. This is the more remarkable as no less than five important serial publications are issued under the auspices of the university, and in large measure are devoted to contributions from its

members. Baltimore has thus taken its place as one of the leading centres of science and learning in our country, and bids fair soon to outstrip older centres in the renown which must follow. The circular for April follows hard after that of March; and we notice in it a number of interesting facts, with abstracts of valuable papers which give an insight into the intellectual delights and activities surrounding the young university. Dr. Brooks gives an outline of the work of the Chesapeake zoölogical laboratory, from its beginning six years ago, dwelling especially upon its service in studying the propagation of the oyster. The lecture of Dr. Martin on modern physiological laboratories, and the account of that lately constructed for the university, are reprinted from *Science*. Reviews or analyses of books published by the officers of the university, and abstracts of papers in philology, history, mathematics, and other branches of science, fill up a large part of the number. We observe that an attempt is to be made to construct a map of the region about Baltimore, including about six hundred square miles, on the scale of two inches to a mile, based mainly on work already effected by the U. S. coast-survey.

— After the U. S. fish-commission steamer Albatross left Aspinwall, April 2, a line of soundings was started for Old Providence Island, about 250 miles distant. Casts were made at intervals of from ten to twenty-five miles. Starting with 707 fathoms, 17 miles from Aspinwall, the water shoaled to 611 fathoms at 27 miles, reached the maximum, 1,900 fathoms, 77 miles from port, and then shoaled gradually to 339 fathoms close to the reef off Old Providence.

On leaving Catalina harbor, on Old Providence Island, April 9, the Albatross laid a course for a doubtful bank 109′ distant, in latitude 14° 53′ north, longitude 80° 20′ west, sounding at intervals of about eleven miles. The water increased gradually in depth to 1,151 fathoms on the reported bank, where it was supposed to break at times. The spot was carefully located by astronomical observations. After crossing a bank lying between Thunders knoll and Rosalind bank, a course was laid north-west for a vigia marked on hydrographic-office chart No. 394 in latitude 18° 30′ north, longitude 83° 16′ west. The depth gradually decreased to 920 fathoms, 75 miles from Thunders knoll, then suddenly increased to 3,169 fathoms at 105 miles. This was the greatest depth found in the Caribbean, and the sounding was made under adverse circumstances. On the first trial, the stray line parted, after something over 200 fathoms had run out, the sounding-rod, water-bottle, and shot being lost. It is difficult to explain this accident, unless it is to be attributed to a shark or some other fish; as the strain on it at the time did not equal one-tenth of its tensile strength. On the second attempt, all the wire was run off the reel without reaching bottom; and the shot had to be reeled in, more wire added, and finally the sounding taken. The bottom was a light yellow ooze, with a trace only of foraminifera.

The currents, which had been light since leaving Old Providence, now became strong and irregular. On reaching the position assigned to the vigia, 66 miles from the deep sounding above mentioned, a sounding was taken in 2,829 fathoms. While making this distance, and taking two intermediate soundings, the vessel was so beset by strong and erratic currents, that it was only by locating each position astronomically that it could be kept anywhere near the desired locality. If these currents have been encountered by other navigators, who were steering a course without taking hourly observations, a very brief period would be required to take them sufficiently out of their reckoning to account, not only for the vigia mentioned, but the soundings of H.B.M.S. Phoebe and Rosario to the eastward of Misterioso bank, which was itself, doubtless, reported in a multitude of positions before it was finally located on the charts of to-day. From this point, the Albatross sailed for Key West by way of Cape San Antonio, reaching port, April 15.

— The annual session of the American oriental society was held in Boston, May 7. Since the last meeting, the society has lost by death an unusually large number of its members; its president, Hon. S. Wells Williams, and Dr. Ezra Abbot, being among the number. Dr. Abbot, who resigned his office two or three years ago, had served the society as recording secretary for more than thirty years. Tender and appropriate tributes were paid to the memory of both of these men; the former having been the foremost Chinese, and the latter the foremost biblical, scholar of America. In the election of officers, Professor Whitney of New Haven was chosen president, and Professor Lanman of Cambridge, corresponding secretary. Baltimore was selected as the place for the next meeting.

Nine papers were presented to the society, four of which discussed Sanskrit topics. Prof. C. R. Lanman gave an account of Protap Chundra Roy's enterprise in furnishing gratuitous editions and translations of the ancient Hindu classics, noticed elsewhere in our notes. He also read a paper on one of the spurious stanzas of the Rig Veda (10, 18, 14), illustrating by remarks on the stanza the subject of Vedic criticism. Professor John Avery of Brunswick, Me., presented a paper on the unaugmented verb-forms in the Rig Veda and the Atharva Veda. Professor Whitney, who read a paper on the study of Sanskrit *versus* that of the Hindu grammarians, showed that a study of the literature itself is the only proper way to learn Sanskrit. He gave many illustrations of the artificial and arbitrary character of the grammars.

Prof. I. H. Hall of Philadelphia gave some notes on a Çippus from Tarsus, now in the Union theological seminary at New York, bearing a Greek inscription. He pointed out that the name Paul, which occurs in the inscription, cannot, as has been supposed, be that of the great apostle. Professor Hall read a second paper on a Shapira roll in Philadelphia. He thinks that no part of this Hebrew document can be older than the last century, while part of it possibly belongs to the present century. The remarkable fact about it is, that an age of more than a thousand years has been assigned to it, which would make it the oldest known Hebrew manuscript. This great

antiquity is supported by a letter from the celebrated Tischendorf. It appears that the late Mr. Shapira, so noted for his dealings in antiquities, palmed off on some too credulous purchaser the Philadelphia roll, aiding himself in the fraud by a letter which Tischendorf had intended to apply to two other rolls. Professor Hall gave, also, some notes on Cypriote inscriptions in the New-York metropolitan museum.

A paper was read from President W. A. P. Martin of Peking, on the northern barbarians in ancient China. Dr. Carl Lehmann of Hamburg read a paper on the relation of *n* to *sh* in proto-Babylonian (Sumero-Akkadian). The fact that *n* in one of the dialects corresponds to *sh* in the other, the reader accounted for by the aid of the transitional sounds *l* and *r*, and he adduced support for his view both from Indo-European and from Semitic grammar. Prof. D. G. Lyon of Cambridge made remarks on some recent Assyrian publications, mentioning his own '*Keilschrifttexte Sargon's*,' Delitzsch's 'The Hebrew language viewed in the light of Assyrian research,' Haupt's '*Das babylonische Nimrodepos*,' Strassmaier's '*Alphabetisches verzeichniss*,' and Bezold and Hommel's '*Zeitschrift für keilschriftforschung und verwandte gebiete*.'

— Quintino Sella, the Italian statesman and *savant*, who died at Biella, March 14, and was buried at Oropa, was born at Mosso, near Biella (Piemont), July 7, 1827, and was named 'the fifth,' as holding that number in a family of sixteen children. His father was a wealthy woollen manufacturer, and he was educated as a mining-engineer at the School of mines in Paris. His scientific works, although few, are all remarkable for their accuracy and acuteness of observation, showing the true spirit of original research. From 1857 to 1861 he published several memoirs on crystallography, — '*Sulle forme cristalline di alcuni sali di platino e del boro adamantino*,' and '*Sulle forme cristalline di alcuni sali derivati dall' ammoniaca*;' later, two important geological and technical descriptions of the valley of Biella and the mining industry of the Island of Sardinia, and also his '*Lezioni di cristallografia*.'

Sella was one of the three founders of the '*Club alpino Italiano*,' October, 1863, and its president at the time of his death. On the 17th of July, 1865, in company with his lifelong friend, Felice Giordano, director of the geological survey of Italy, Sella undertook the climbing of the Matterhorn (Sylvio or Cervin) from the Italian side, starting from Breuil in the Val Tourmanche. After an unsuccessful attempt, they reached the summit only three days after the celebrated ascension of Whymper and his unfortunate companions. As president of the Reale accademia dei lincei of Rome, he remodelled entirely this old scientific institution, which was removed in January last to the celebrated palace Corsini. He was also president of the International geological congress at Bologna, 1881; corresponding member of the Institut of France; and foreign member of the Geological society of London.

As a statesman, Sella ranked among the first. He was thrice secretary of the treasury, and chief of the constitutional party of the right. On his first appointment to the treasury, in March, 1863, he found Italy on the verge of the greatest financial difficulties, if not of a catastrophe; but, by his good management, in less than ten years he restored the Italian exchequer to a normal condition, balanced the expenses with the receipts, and has been justly called, by the president or speaker of the house of representatives, the '*Salvator del l'onore d'Italia*.' The '*Camera dei deputati*' has appropriated '100,000 *lire, per un monumento alla memoria di Quintino Sella*,' to be erected in front of the treasury (*Ministerio delle finanze*) at Rome.

— Protap Chundra Roy is a wealthy gentleman of Bengal, who has retired from business, and is devoting his leisure to the work of the Bharat Karyalya. This is an organization somewhat similar to the American tract society, but with a strangely different purpose. It is an institution for the printing and gratuitous distribution of the classics of India; the Mahā-bhārata, the Rāmāyana, and the Harivansa being the works first chosen. Already 13,783,500 printed forms have been gratuitously distributed, or are in course of distribution. Such a surprising result of well-directed and truly patriotic zeal deserves to be mentioned and recognized by all who are interested in the elevation and enlightenment of India, and especially by Sanskrit students in America. For Chundra Roy is now undertaking the publication of an English prose translation of the Mahā-bhārata in an edition of twelve hundred and fifty copies, two hundred and fifty of which, according to the generous and wide-reaching plans of Mr. Roy, are intended for the scholars of Europe and America. Sanskrit scholars, therefore, who desire to have their names placed on the free list, may forward their addresses to the publisher, No. 367 Upper Chitpore road, Calcutta, British India.

— Dr. Höpfner and a young scientific companion will shortly start for Ovamboland and the interior of Africa to explore for the Bremen geographical society. They have been supplied with instruments for astronomical observations by a member of the society: in return, they will send home periodical reports of their progress, and charts of the district explored. The same society is sending an expedition to Bonin Island, South Japan, to investigate its geography and natural history.

— At Ekhmeem, a large provincial town of Upper Egypt, situate about halfway between Assiout and Thebes, Professor Maspero, returning from his annual trip of inspection up the Nile, has just found, according to *Nature*, a hitherto undiscovered and unplundered necropolis of immense extent. As far as has been yet ascertained, the necropolis dates from the Ptolemaic period; but, as the work of exploration proceeds, it will probably be found that it contains more ancient quarters. The riches of this new burial-field would meanwhile seem to be almost inexhaustible. Five great tombs or catacombs, already opened, have yielded a hundred and twenty mummies; and, within the short space of three hours,

Professor Maspero verified the sites of over a hundred more similar catacombs, all absolutely intact. The necropolis of Ekhmeem, at a rough estimate, cannot contain fewer than five or six thousand embalmed dead. Of these, perhaps not more than twenty per cent will turn out to be of archeological or historical value; but the harvest of papyri, jewels, and other funeral treasures, cannot fail to be of unprecedented extent. Ekhmeem is the ancient Khemnis, — the Panopolis of the Greeks. Its architectural remains are insignificant.

— The Alert, the store-ship of the Greely relief expedition, and the last of the vessels to sail, left New York, May 10. The Bear sailed from New York on the 24th of April, and reached St. John's, May 2; while the Thetis, the flag-ship of the fleet, and supposed to be the stanchest of the three, sailed from New York on that day, and reached St. John's on the 9th. Every thing that could be suggested in the way of equipment has been done for the party, and it is to be hoped that the pluck and discipline of the *personnel* will atone for their lack of experience.

— The subject of the thesis for the annual Walker prize of the Boston society of natural history, this year, was 'The life-history of any animal or plant.' Two essays only were offered in competition, and the first prize only was awarded: this was gained by Mr. Albert H. Tuttle, of the Harvard medical school, Boston, for a study of the embryology of Lunatia heros, with numerous illustrations.

Prof. A. E. Verrill has in press a very important paper entitled Second catalogue of Mollusca recently added to the fauna of the New-England coast and adjacent parts of the Atlantic, consisting mainly of deep-sea species, with notes on others previously reported. These are chiefly derived from the dredgings of the fish-commission, are well illustrated, and worked up in the full and careful manner characteristic of the author. It appears in the Transactions of the Connecticut academy of sciences, and is illustrated by Emerton.

— The annual report of the zoölogical gardens of Cincinnati states that over eight hundred animals are on exhibition, and that a hundred and twenty-seven were bred in the gardens last year, including a grizzly bear. The most noteworthy addition during the year was that of a young hippopotamus, which promises to become the main feature of the collection. Nearly twenty-eight thousand dollars were received from visitors' fees.

— The additions to the American museum of natural history in New York seem not to have been so numerous or important last year as in previous years. The museum has, however, received its first bequest (five thousand dollars, from Mr. W. E. Dodge), and makes it the occasion to establish a permanent endowment-fund. The absence of such a fund, and the absolute dependence of this fine museum upon annual subscriptions and grants, have been very weak points in its organization, and have seriously disturbed its scientific friends. They will not be satisfied until it is permanently endowed.

— The New-York anthropological society was organized Dec. 28, 1883, the aim of which is to prosecute researches in the sciences of anthropology and psychology.

— In the third *Bulletin* of the Natural history society of New Brunswick, just issued, Mr. G. F. Matthew describes in detail the discovery and examination, by a small summer party belonging to the society, of a village of the stone age, at Bocabec, on Passamaquoddy Bay. Indications of the former site of over thirty huts were recognized, each of circular form, bordered by a raised edge of gravel, and surrounded by the shells of a kitchen-midden. A plan of the village, and a section of one of the more typical hut-bottoms, is given, together with descriptions of the various articles—including implements of stone, bone, and ivory, as well as pottery — found in and around them; and various conclusions are drawn as to their antiquity, and the habits, food, and ethnic relations of their former possessors. The *Bulletin* also contains a report of the botanical committee, giving a list of over eighty species first found in the province during the last year, and of which one (Ornithopus scorpioides L.) is probably new to America; and a list, the first authentic one yet published, of New-Brunswick mammals, by M. Chamberlain. It includes forty-three terrestrial, and five marine species. It is noticed, that, while the panther and wolf have nearly or quite disappeared, the Virginia deer (Cariacus virginianus), though still not common, is increasing.

— The New-Brunswick legislature, at its last session, appropriated two hundred dollars towards the assistance of the Natural history society of the province. This is the first recognition of the claims of the society upon the public for support, and will be of much service in helping to defray the cost of publication of their bulletins.

— Mr. G. F. Matthew, whose elaborate article on the Paradoxides of the St. John group is contained in the recently published Transactions of the Royal society of Canada, has in preparation, and will present at the next meeting of the society (May 20), a similar article on the Conocoryphidae of the same group.

— The California academy of sciences has commenced the issue of a new publication, called *Bulletin*, apparently to replace the former Proceedings. The papers in this first number are classified under zoölogy, botanic section, microscopic section, astronomy, and mineralogy, and are mostly very brief and descriptive in character.

— The Calcutta *Englishman* announces another important result in the investigation of the causes of cholera. Dr. Vincent Richards, civil surgeon of Goalundo, has succeeded in doing what the German commission have hitherto failed to accomplish: he has produced the disease artificially. The subjects of his experiment were pigs; and, after many trials, he communicated to one of them what appears to have been

genuine cholera, the animal having died within three hours after the cholera-poison had been administered.

—M. Pasteur and his *collaborateurs* have announced to the French academy that they can render all dogs absolutely proof against the effects of rabies by inoculation, however the virus may be administered.

— Under the heading 'Expeditions to the Kongo region,' the *Frankfürter zeitung* states, that, according to information obtained from a well-informed source, Dr. Passavant of Basle, and Dr. Pauli of Brunswick, arrived, at the end of February, at Madeira, where they met Dr. Chavanne of Vienna. The three travellers were to proceed almost immediately to Africa. Passavant and Pauli, who are travelling at their own expense, proposed to penetrate the interior from the Cameroon delta on the coast of Guinea. Dr. Chavanne, who was to be joined at Madeira by Dr. Lintgraf of Detmold, is, it is stated, directly employed by the king of the Belgians. He has been commissioned to trace the route for a narrow-gauge railway to connect the coast with Leopoldville and Stanley Pool. He intended to proceed directly from Madeira to Banana, and take as the point of departure for his expedition, " the mouth of a small river situated about 5° south latitude." Having completed the survey for the railway, he is to proceed in a north and north-east direction, to explore the course of the River Uelle; the object of this exploration being the establishment of a connection between the Kongo and the Nile. The country situated to the south of the Kongo is to be explored at the same time by Lieut. Wissmann, also on account of the king of the Belgians. Dr. Chavanne was to be joined at Banana by a hundred Zanzibaris; and seven hundred additional Zanzibaris were awaiting there the arrival of a steamer to be sent from Europe, in order to transport it, under the command of Belgian and English engineers, above the falls of the Upper Kongo, to be utilized in Dr. Chavanne's exploration.

— The *Athenaeum* of March 29 states that Coudreau, J. Roche, and C. Demont have arrived at Para. They will devote two years to the exploration of the Amazon basin; paying particular attention to anthropology and natural history, without neglecting purely geographical and commercial questions. They travel under the auspices of the French ministry and marine.

— Dr. Nathorst, of the late Swedish expedition to Greenland, has just issued his report on the geology of Waigatt Strait, near Disco Island, and on the attempt of the Sofia to reach Cape York in 1883.

— The fourth volume of the *Meddelser om Grönland* has appeared, with important contributions to the knowledge of that region. Hammer contributes a study of Jacobshavn Fiord, made during the winter of 1879–80. Another chapter, on the glaciers of North Greenland, is the work of Steenstrup, who also reports on the deposits of nickeliferous iron ore, and on the geognosy and geography of a part of North Greenland. The book also contains researches on the composition of the native iron of Greenland, by Lorenzen, and astronomical positions determined in North Greenland, by Steenstrup and Hammer. It is well illustrated, and contains a *résumé*, in French, of its contents, by Professor Johnstrup. The two succeeding volumes are in press, and will contain a study of the miocene and cretaceous fossils of North Greenland, with an account of the explorations made on the east coast of that country by Messrs. Vandel, Normann, and Holm.

— The royal society of Canada will hold its next annual session at Ottawa, May 20 and following days.

— The work of the Austrian geological institute has been carried on, the past year, by Stache and Teller, with the temporary co-operation of Berwerth and Baron Camerlander, in the central chain of the Tyrol and the easternmost portion of the frontier of Carnithia; by Mojsisovics, Bittner, and Vacek in the north-western part of Styria and in the revision of the calcareous Alps of Salzburg; by Paul and Uhlig in the Carpathians of Galicia; and by Tietze and Hilber in the other portions of Galicia. Von Hauer and Mojsisovics also examined the thermal springs in Baden (south of Vienna), whose temporary intermittence had caused grave apprehensions; and Mojsisovics visited Bosnia, Istria, and Trifail, in Styria, with reference to coal-deposits. Stur studied the coal-formation of Taworzny in Galicia, where the mines had been much damaged by the irruption of water. Paul examined several petroleum districts in Galicia and North Hungary, and searched for coal and salt deposits in the neighborhood of Tuzla in Bosnia, where a boring, executed under his direction, met, at a depth of ninety metres, water saline enough to be used for industrial purposes. Böhm investigated the glacial phenomena in the valley of the Enns. Frauscher studied the eocene faunas of the northern Alps of Upper Austria; Geyer, the todtegebirge of Upper Styria; and Tausch, the cretaceous deposits of Ajka. The library now contains about twenty-nine thousand volumes.

— The commission for the geological survey of Bohemia reports, that, during the past year, Krejci and Feistmantel studied the still imperfectly known western Silurian deposits, which are interrupted by great faults, parallel to the strike of the whole system, and causing a great number and diversity of synclinal and anticlinal foldings; Fritsch surveyed the Teplitz strata, near Podiebrad and Chrudim, and Kafka the Chlomek strata in Glatz; Laube continued his investigations in the metalliferous region of Kaaden and Komotau; the passage of the railway through this region proved that the anthracite zone of the Saxon Erzgebirge continues along the borders of the porphyritic region, at a distance of about five kilometres from the Saxon frontier. As is usually the case in the metalliferous regions of Bohemia, no traces of glacial action could be discovered.

— Mr. J. F. Whiteaves, paleontologist to the Dominion geological survey, has just issued art. iii. of vol. i., Mesozoic fossils, of the paleontological series of the survey, on the fossils of the coal-bearing beds

of the Queen Charlotte Islands, collected by Dr. George M. Dawson in 1878. The formation, by these data, is shown to be cretaceous rather than Jurassic, and is unconformably overlaid by tertiary strata, showing evidence of great disturbance, and supposed to be the representatives of the chief period of mountain-making for the region. The fossils are nearly all molluscan.

— The Marquis de Gregorio has recently published a number of paleontological notices in the *Naturalista siciliano*, which chiefly relate to tertiary forms, especially members of the family Pectinidae, of which, and of the Ostreidae, he has made a special study. He has also proposed, should four hundred subscribers offer themselves, to bring out an international geological and paleontological journal, the articles to be in the languages of the respective authors, and to be copiously illustrated. A bibliography, in French, of geological literature, would form a prominent and useful feature of the proposed journal.

— At the meeting of the Royal astronomical society in March, Dr. Gill, director of the observatory at the Cape of Good Hope, gave the following account of his arrangement with Dr. Elkin, which resulted in the measurements of stellar parallax already described in *Science*: "When I was in Strasbourg in 1879, before going to the Cape, I met a young student, Dr. Elkin, a pupil of Professor Winnecke. He was then engaged in writing his dissertation on the parallax of α Centauri, and he requested me to send him observations, which might have been made at the Cape, of that star. At the same time, I told him that I had acquired by purchase Lord Lindsay's heliometer, and intended to have it mounted equatorially at the Cape, to carry on the work of investigation of stellar parallax. This seemed to fire his enthusiasm, and he expressed a great desire to go with me and share my work. I said I could offer him no position, and he replied that he did not want one. So I said, 'If you will be my guest, and come and live with me and share my work, you will be most welcome.' He said he should be happy to do so, and he came to me so soon as he had taken his degree. So we have undertaken a certain amount of work together, and I should like to give a short account of it."

In the account which follows, he refers to the parallaxes of α Centauri and Canopus. The result was about 0.75″ for α Centauri, which shows it to be the nearest known fixed star to our system, though farther than was formerly supposed. The most curious result, however, is that for Canopus, or α Argus, which is, next to Sirius, the brightest star in the heavens, and might therefore be supposed among the nearer ones; but the resulting parallax is only 0.03″, a quantity too small to be relied upon. It would therefore seem that this star is probably ten times the distance of Sirius. In the same connection, Dr. Gill presented to the society an unpublished investigation by Struve, at Pulkova, which gave a parallax of 0.5″ for Aldebaran, a star which no one seems to have before attacked for parallax purposes.

— Professor Pickering, whose work in stellar photometry is so widely known, during his last summer's visit to European observatories was very fortunate in discovering valuable unpublished manuscripts of a large part of the photometric work of Sir William Herschel. First in importance were two unpublished catalogues, which, with the four published in the *Philosophical transactions* of the Royal society, complete the determination of the brightness of all the stars of Flamsteed's catalogue at a time when no other estimates of their magnitudes are known to exist (about a hundred years ago). Professor Pickering's reduction of these catalogues by comparison with a uniform photometric scale (the logarithm of whose light-ratio is 0.4) has shown that Herschel's estimates of magnitudes were much more accurate than has been generally supposed, thus rendering the discovery of the two additional catalogues all the more valuable.

Of much importance, too, was the discovery of the journal of the original comparisons, whose results are contained in all six of these catalogues, thus giving the date of each comparison. At the suggestion of Mr. Chandler, whose forthcoming bibliography of variable stars will be of great value, the observations of the variable stars contained in this journal have been examined with the idea of correcting or checking the periods of some of the well-known variables by these older observations; and the results are given in a paper recently presented to the American academy of arts and sciences by Professor Pickering. The periods of many of the later discovered variables are so irregular, or so little is known of them, that Herschel's observations of these cannot be utilized till these periods are better determined from further observation or discussion; and thus, much of the value of these old observations is still to be determined in the future; but it is well to know that they are now accessible. In the case of two or three of the variables, however, they are sufficient to give corrections to the periods which are of some value, and would be still more so if Herschel had only given the hour, as well as the night, of observation. As it is, the times can only be fixed between the limits of twilight and rising or setting of the star, unless, as the writer would suggest, the order and number of the observations in any one night might fix the limits of time a little more closely in some cases.

— It may not be generally known in the United States, that the publication of the *Journal de zoologie* and of the *Revue et magazin de zoologie* has ceased; that of the former in consequence of the death of Professor Gervais, of the latter for other reasons. As the *Bulletin* of the *Société zoologique de France* covers the scope of these journals, and as the *Société* is very desirous of entering into relations of exchange with the American institutions, it is suggested by the secretary of the Smithsonian institution, that the transfer in question of the address should be made. The institution, as heretofore, will take much pleasure in transmitting parcels addressed to the *Société zoologique*, or to any other of the learned bodies of France.

SCIENCE.

FRIDAY, MAY 23, 1884.

COMMENT AND CRITICISM.

The popular excitement as to food adulterations, and the difficulties met in dealing with this evil, lead to some queer results. The city of New York, with its vast population demanding supplies of cheap food, takes an extraordinary position as regards the two common articles of butter and milk. Instead of courageously undertaking the proper restriction and regulation of substitutes, and the prevention of fraud, the city authorities, through the board of health, now supported by the state legislature, propose to expel from the city markets all imitations of butter, and all skimmed milk. Oleomargarine and butterine have never competed with fine grades of butter. But, made in a healthy and clean manner, the substitutes have formed a legitimate, cheap, and palatable substitute for low grades of pure butter. Sold for what they are, a certain class prefer the imitations to poor butter, although genuine; but prohibition is to prevent this, and force up the prices of low-grade butter. Worse yet, is the exclusion of skim-milk from the city. One of the most wholesome and really valuable food-products, which, sold as skim-milk at a low price, would find a market almost unlimited, and prove a great blessing to the poor, is prohibited, and emptied in the gutter whenever found. The science of government must sadly need development, so long as it is thought necessary to thus cut off supplies of cheap and wholesome food from the poor of our great cities.

Every one remembers as one of the familiar, or perhaps better unfamiliar, sights of his school-days, a cabinet, — a closet with glass doors, containing a piece of quartz, a shell, a leg of a chair, and dust. Some one stirred by a love of nature, awakened for a moment by an essay at his teachers' convention, had been misled into placing the glass-doored case in one corner of the schoolroom, and the quartz and shell behind the glass. So it had stood for a week or month admired, then for six months neglected, and finally for years despised, during which last period the chair-leg had been added to the contents.

It would seem that this ghost of a cabinet haunts the English schools as much as ours. Ghosts love half-neglected, half-forgotten corners, and are quickly banished by plenty of new paint, and a proper use of the broom. To put an end to the haunting school-cabinet, a remedy is suggested by Rev. Henry H. Higgins, who proposes that a loan-museum shall be formed for the supply of schools with a few specimens at a time in the departments which the scholars may be studying. As a loan-museum will have, like a circulating-library, a limit to the time a specimen may be retained, there will be no chance for the stagnation which now takes place. It is also hoped that the museum would be able to supply a much better class of specimens than the schools could afford.

Mr. Higgins differs from many advocates of object-lessons in thinking that it is better to place before scholars first, not the common things of their neighborhood which may have beauty, but a beauty overlooked because too near, but "would take the large and beautiful exotic shell, Pinna, with its byssus of glossy silk, and the fashionable-colored gloves made of this material, and, after operating with these, would require the class to bring a large cluster of common sea-mussels, and would make the children find the silk-byssus." His idea appears to be, that the advantage of a child's being interested in a novel sight is not to be thrown away by disappointing him with a toad, and then showing him that he does not know all about toads.

AT the April meeting of the Royal astronomical society, Mr. Tupman announced that Dr. Arthur Auwers of Berlin had communicated to the society a paper on the chain of meridian distances, measured around the earth, between 1831 and 1836, in H. M. S. Beagle. Capt. Fitzroy was in command of the Beagle at that time, when she set out from Bahia, and went round the world, returning to that point. In working out the results, his selection of the chronometers upon which he based his determinations was somewhat arbitrary; and he found that the successive differences of longitude round the world, when added together, differed from twenty-four hours by thirty-four seconds. Capt. Fitzroy did not attempt to improve upon this; and the work has been left in that state until now, when Dr. Auwers has taken it up, and discussed anew all the chronometer-work on board the Beagle, using as the primary meridians those which have been correctly determined since, and correcting in this manner all the longitudes which resulted from the discussion of Capt. Fitzroy. Dr. Auwers's paper will be published in the *Monthly notices* of the society; and, as Fitzroy's longitudes have been to a great extent relied upon by the Hydrographic office in the construction of maritime charts, many of which are in use at the present day, the work of Dr. Auwers will be of great value in giving more accurate determinations of the longitude of distant islands than were before available.

WHEN one passes through some sleepy New-England village, and has pointed out to him a building as the academy at which his grandfather or great-uncle once learned his Latin grammar, he wonders how his uncle, now selling stocks on Wall Street, or pleading before the full bench in Washington, or hoeing corn in Kansas, and this quiet building, should have come together, and why they parted, — an academy, a square building, with hip-roof, a belfry in the centre, and coated with paint of that sobered tone derived of a mortgage. There are no little uncles running about the building now; the chief life, or it might be said the soul, of the structure, existing in the records of the school (the newest quite yellow), the deed of the land, and an expired insurance-policy on the building, — a crumpled bundle of papers in the desk of the village doctor and only resident graduate, an enthusiast on the school, puffed with pride at his own success as a wiseacre.

Such is the dead or dying academy, of which each town can produce its sample. A few, a half-dozen, still flourish, thanks to a rather more liberal endowment, or the fortunate circumstance of a long run of successful masters. Just at present there are some stirring the old bones to find those that may show sufficient signs of life to warrant an attempt at resuscitation, — a revival of interest possibly due as much as any thing to the restlessness of human nature, not contented with the high-school system developed as far as may be for the present.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The faults of south-western Virginia.

WHILE engaged in making a series of cross-sections in the above region in 1880, I had very frequent opportunity to study the structure of the faults; and, as a result, I reached certain conclusions, which may be of interest.

A conspicuous feature, which is of general, if not universal, occurrence along the line of faults, wherever exposed, is an angular fold, as in fig. 1.

An excellent section, showing its manner of occurrence, is found at the mouth of Russel Creek, a tributary of Clinch River. It is given in fig. 2, where, at *a*, coal-measures occur nearly horizontal and undisturbed; at *b* the millstone grit is standing vertically, forming an obstruction to the creek, and giving rise to perhaps the loftiest and most picturesque fall in the region; *xy* is the fault-plane (seen in the vicinity), to the left of which the Knox limestone (*c*) shows a dip closely conforming to that of the fault-plane. Other examples might be given, but the above will sufficiently illustrate the general character.

At first I regarded them as a result of the faulting, produced by friction along the fault-plane; but further observation led me to the opinion that they preceded, and determined the location of, the faults. I was first led to this opinion by finding a fold, much like fig. 1, finely exposed in the line of a small fault at one end, where the displacement had diminished it little or nothing.

Other reasons for so thinking are, 1°, that, although of such general occurrence in connection with the faults as to suggest a very important relation between the two, they are not dependent on the faults, since

they occur abundantly out of the vicinity of faults; 2°, that the fault-plane, wherever exposed, shows such a dip (about 45°) as it would naturally have if determined by one of the angles of the fold; 3°, that the angles of the flexure form a line of least resistance, along which displacement would certainly occur, did any force tend to produce it; 4°, that numerous indications in this region point to great superficial tension.

Fig. 1.

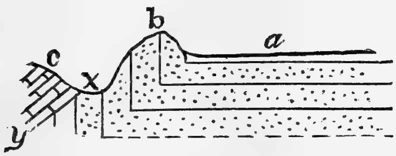


Fig. 2.

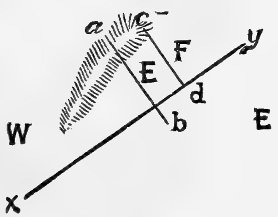


Fig. 3.

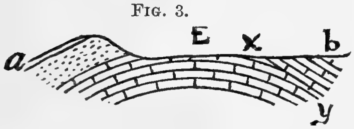


Fig. 4.

I think all of the above reasons will sufficiently explain themselves except the last, in illustration of which I give a very interesting section occurring in the region known as New Garden, in Russel county.

In the plan, fig. 3, $x\,y$ is the line of Clinch-Mountain fault, from which a short fault, $c\,d$, goes off at right angles, on one side of which, F, the coal-measures are nearly horizontal and undisturbed. On the other side the strata are pressed into a fold, as shown in the section, fig. 4, where $x\ y$ is the fault-plane; E, the subcarboniferous limestone; b, the Knox limestone; and a, the coal-measures forming the crest of a lofty mountain.

There are no signs of igneous action along any of the faults, unless the evidences of ancient thermal springs along the line of Walkers Mountain fault be so regarded. These indications are, 1°, the band of gypsum, which for many miles skirts the fault on its south-east or upthrow side, at a distance of about a half or three-fourths of a mile from the fault-line (it is the same as that mentioned by Mr. Bien in *Science*, April 18, but does not, as he seems to surmise, enter Burk's Garden, which is some distance away on the opposite side of the fault); 2°, the Saltville basin, the bottom of which is, by estimate, not less than two hundred feet below the bed of Holston River, the excavation of which in the limestone must be accounted for by other agencies than ordinary river-erosion; besides, its structure is such as to render it improbable that it ever formed a portion of a river-valley.

In conclusion, if there were, as assumed, an increase of tension by lateral pressure toward the surface, disturbances of strata would begin near the surface, resulting in sharp folds of the character described, which, in turn, would determine the locality of the faults, the tendency of which would be to extend progressively downward. G. H. Squier.

Trempealeau, Wis., May 10.

Assumptions of museum-keepers.

In Mr. Goode's interesting summary of 'The exploring voyage of the Challenger,' I notice a paragraph that merits attention. Recalling the fact that the deep-sea fishes have been in Dr. Günther's hands 'now eight years,' and lamenting the delay in publishing the results, he very justly says, that "the preliminary descriptions published in 1878 are so meagre as to be nearly useless to any one except their author," and immediately adds, that "the type specimens themselves will, *of course*, be inaccessible for comparison until the final report is in type" (*Science*, iii. p. 580). Had it not been for private information with which I had been favored, I might have supposed that the concluding paragraph was an example of what has been called 'heterophemy,' and that my excellent friend had intended to say that the type specimens themselves will, *of course*, be accessible for comparison. It was, however, with the greatest astonishment that I learned, some months ago, that access had been denied to the collection in question by Dr. Günther, and that, for instance, an eminent and accomplished European ichthyologist, on a visit to England, had been refused the *right* of examination. I say advisably *right* rather than *privilege;* for I had always believed that the British museum was a *public* institution, supported by liberal grants from the nation, and created to facilitate and promote scientific investigation, and *not* intended for personal aggrandizement, or to uphold any officer in petty spite. On what possible ground can Dr. Günther withhold the opportunity for examination of any specimens in his keepership to any competent naturalist? It may be conceded, *causâ argumenti*, that he has a right to name any specimens, and, at any rate, the matter is of too small moment to question at present; but I do not know on what principle he can withhold a sight of any specimen for a day even. A naturalist has, doubtless, a right to keep his own collection, bought with his own money, secluded, and to deny the privilege of examining a specimen to any one, although I have more than once heard such a procedure designated by the forcible and expressive, even if inelegant, word, 'hoggish;' but such action is worse than illiberal, and becomes criminal, in the case of a public officer. It is criminal because it is a breach of trust; for the custodian is a keeper, employed and paid by the government to care for the collections amassed for the people. Denial of the opportunity to examine such collections, under proper restrictions, may also, as intimated by Mr. Goode, result in the direct retardation or suppression of scientific activity. If Mr. Goode and my private information are correct in fact, the policy of the British museum, as interpreted by at least one of its officers, is petty, selfish, hindering to science, and subversive of public trust, or the officer exercising such powers is criminal in monstrous usurpation of delegated authority. In any event, a protest is called for; and I, for one, do make protest against such and all similar restrictions. While constant clamor is made, in the nominal interest of 'science,' for appropriations to advance scientific investigation, we may at least demand that the trustees for handling such appropriations shall not become barnacles to prevent its healthy progress. Theo. Gill.

Washington, May 10.

Hibernating mammals.

An article on hibernating mammals, by Dr. C. C. Abbott, in *Science*, No. 65, contains several statements the correctness of which I am inclined to challenge. For example: Dr. Abbott says, "Of the thirty or more mammals found here [central New Jersey], thirteen species are supposed to be hibernating animals. These are four species of bats, two of moles, three squirrels, one ground squirrel, one marmot, one jumping-mouse, and one Hesperomys."

If it is true that the red squirrel, 'two moles,' and 'one Hesperomys' hibernate in the latitude of central New Jersey, the fact is sufficiently interesting and important to merit a detailed account of the evidence upon which an announcement seemingly so extraordinary and improbable is based.

Further on, the doctor states that the common star-nosed moles "form commodious nests, placing a good deal of fine grass in them. Here, indifferent to freshets, they remain all winter, and, as they can lay up no food, sleep, I suppose, through the entire season. The fact that these moles are unaffected by being submerged during the spring freshets is an interesting fact." Here, it will be observed, the author not only asserts that the star-nosed moles 'remain all winter' in their nests; but, without adducing a single fact in proof, he even goes so far as to assume that they are 'submerged during the spring freshets,' and goes on to say, "I think that the animals must have been thoroughly soaked for from forty-eight to seventy-two hours, the ordinary duration of the high water." Now, it is a very easy matter for these semi-aquatic animals to betake themselves to higher ground when driven from their usual haunts by freshets; and this is exactly what usually takes place, as I have ascertained by personal observation.

In the Adirondack region, where snow covers the ground for five or six months of the year, the star-nosed mole does not hibernate. At the approach of winter, it sinks its galleries below the depth to which frost penetrates, and still finds an abundance of earth-worms, which at all seasons constitute a large share of its food. When the snow has attained the depth of a metre or a metre and a half, as it commonly does here during January and February, the frost gradually leaves the ground, and both moles and earth-worms again approach the surface. The moles sometimes burrow up through the snow; and I have captured them while running about on a stiff crust, through which they were unable to bore in time to make good their escape.

The red squirrel is well known to be the hardiest of his family. Disdaining to hibernate, he remains active throughout the continuance of excessive cold. When fierce storms sweep over the land, he retires to his nest, to re-appear with the first lull in the wind, be the temperature never so low. I have frequently observed him when the thermometer ranged from 30° to 40° below zero, Centigrade, but could never see that he was troubled by the cold. While running on the snow, he often plunges down out of sight, tunnels a little distance, and, re-appearing, shakes the snow from his head and body, whisks his tail, and skips along as lightly, and with as much apparent pleasure, as if returning from a bath in some rippling brook during the heat of a summer's afternoon.

Dr. Abbott, after commenting upon the fact that the jumping-mouse (Zapus Hudsonius) lays up no store of provision for winter, while the white-footed mouse (Hesperomys leucopus) invariably hoards, says, "However this may be, the fact remains that both these rodents are quite sensitive to cold, and hibernate as soon as winter sets in; yet how very differently is this faculty exercised!"

The white-footed mouse is the last animal of which I should say, 'sensitive to cold.' Like the red squirrel, it is one of the hardiest of rodents, and in our northern forests it remains active throughout the long and severe winters. It is not known to hibernate; and, except during very stormy weather, its footprints can always be seen, dotting the snow in various directions.

If animals that are active in winter throughout the north-eastern part of the United States and much of British North America should be found hibernating in a mild climate like that of central New Jersey, the fact would be of unusual interest; but, since its acceptance must upset the well-known laws that govern the physiological process of hibernation, it becomes expedient to sift well the evidence upon which such statements rest. C. Hart Merriam.

Experiments with reflections.

The accompanying figures, though not perfectly accurate copies of photographs I have made, are at least truthful representations of reflections obtained from, 1°, rectilinear striations upon a polished plane; 2°, circular striations upon a disk; 3°, circular striations upon a sphere.

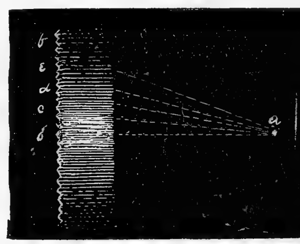


Fig. 1.

In fig. 1 the direct rays from a luminous point, *a*, touching the rectilinear striations at *b*, return to the eye a brilliant reflection of the luminous point; the divergent rays at *c*, *d*, *e*, *f*, returning the same with decreasing brilliancy as the remoter striations are reached. Thus a band of light is reflected perpendicular to the striations, of uniform transverse diameter, and with an intenser luminosity at the central point. If the striations are upon a finely polished surface, the outline of the luminous point is preserved in the reflection quite sharply, whether circular or otherwise.

If the striations are circular and concentric from circumference of a disk, — the centre of the disk, the light, and the eye occupying the same plane, and the face of the disk perpendicular to it, — the reflection is two equal sectors, with their luminous apices united at the centre of the disk, as in fig. 2. The diameters of the intercepted arcs depend upon the angle formed by the incident and reflective rays. Variations of the light, disk, or eye, in position, produce every degree of difference between the two sectors.

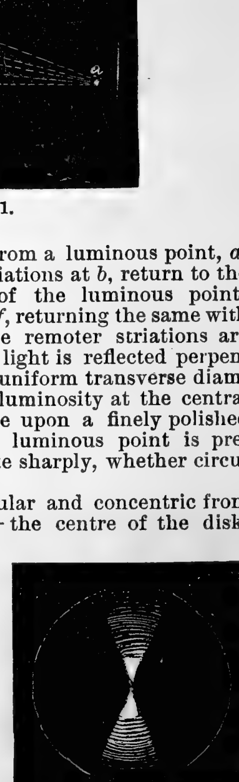


Fig. 2.

If the striations are upon a polished sphere, and

are parallel with its equator, the axial extremities become well-defined poles.

Place the equator of the sphere, the light, and the eye, in the same plane, and the axis of the sphere vertical to it. Make the reflective angle as acute as possible. The reflection is a central luminous point

FIG. 3.

FIG. 4.

at the equator in a vertical band terminating acutely toward either pole, fig. 3. If the reflective angle is about 90°, the reflection is crescentic, fig. 4. When the sphere is placed remote from the light and the eye, with its axis inclined toward the light, the reflection is a luminous point at its proximal pole, fig. 5.

If the sphere is brought nearer the light, thus increasing the reflective angle, a short curved tail de-

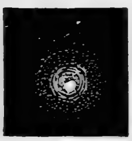


FIG. 5.

FIG 6.

velops, fig. 6. This increases in length as the sphere is approached to the light, until, at close proximity, *a*, in fig. 7, results. Removal of the reflecting surface at any latitude on the sphere interrupts the reflection, as at *c*, fig. 7. The interposition of a comparatively small opaque body before the light, when the inclined sphere is in *very* close proximity to the light, divides the reflection, — *a*, *b*, fig. 7. Multiple sources of light multiply the reflections, which describe different curves, all radiating from, though not always reaching, the pole. The greater the sphere in relation to the source of light, the more perfectly the form of the luminous point is reflected. If circular, it appears as a disk or brilliant nucleus. The extension of the reflection toward the equator constitutes a diverging train or tail.

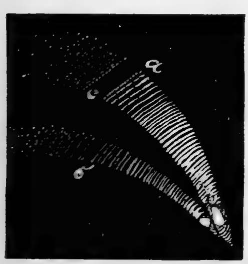


FIG. 7.

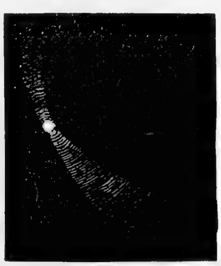


FIG. 8.

Changes in the positions of the three factors produce a limitless variety of figures, which are suggestive of various cometic forms: for instance, fig. 8, two opposite spherical sectors, the analogue of figs. 1 and 2. The resemblance of the reflections to cometic appearances is increased if the striated reflecting sphere, with the inclined axis maintained, is made to describe about a light approximately the form of a comet's orbit; then all the changes exhibited by a comet, from the first nebulous point to the fully-developed tail, are illustrated upon its surface, including the changes in the position of the tail in relation to the light, which occur during the small curve of a comet's orbit. The reflections describe all the radii between *a* and *b*, fig. 9. It is surprising to what extent cometic behavior may be illustrated upon the polished spheres: position, elongation, abbreviation, disappearance, annular images, irregular images, are all quite possible.

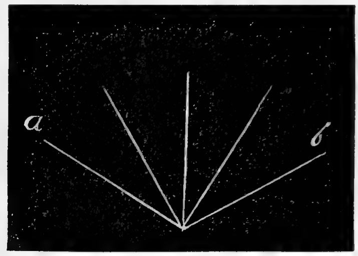


FIG. 9.

If an hypothesis may be ventured, it is briefly this: if a sphere of meteoric dust of a diameter exceeding the greatest length of the comet's train, having an axial rotation and inclination, does actually traverse the comet's orbit, such a rotation would convert its superficial inequalities, varying densities, and possibly its individual atoms, in effect, into continuous striae, parallel with its equator; and such inclination would place it in position to reflect the images which comets display. Discussion of the hypothesis is reserved.

GEO. O. WILLIAMS, M.D.

Greene, N.Y.

THE BIOLOGICAL INSTITUTE AT PHILADELPHIA.

NOT a few of the readers of *Science* are looking upon the new departure in biology in Philadelphia with high hopes that it may become one of our most valued possessions. They regard it as a new and therefore great opportunity. But they will be sadly disappointed if its officers give themselves up largely to merely routine teaching, or are satisfied in taking a position towards biological science in any large degree conservative. The United States is a poor field, or is rapidly becoming so, for the perpetuation of ancient methods in one of the youngest and most vigorously growing of the sciences. And if any one cares to profit by experience, let him reflect upon those steps, which, within ten years, have led up to one of our most valued institutions, — the Johns Hopkins university, — or to the almost incredible success of the Naples station. Broadly speaking, their conditions of prosperity have been two, — on the one hand, money;

on the other, methods. A firm financial basis is always absolutely indispensable; and this, we understand, the new department is to have in abundance. The second requisite is equally imperative. The university just now mentioned had abundant means; so had others before it: but it invoked new methods. True, these seemed to some, at the outset, revolutionary; but who can deny that they have been a success? It was because of this great importance of absolute freedom that some felt it to be safer for the new establishment in Philadelphia to steer clear of affiliations, however exalted; and it was for this reason alone. The advantages accruing to both the University of Pennsylvania and the biological institute (or department), by union, are too obvious to need discussion; and both are to be congratulated, provided only that that liberty be granted which will insure the employment of the best methods.

As to the exact line of work to be done, or the methods to be set going, we may safely trust to the discretion of the new faculty. Evidently, museum-work in the older sense, and elementary teaching by the older methods, may be neglected. And it will very likely be found true that great opportunities are embraced in the hunt for new methods of work, — in technique, — and especially in field-work at the sources of supply. The American mind is quick, inventive, ingenious. Must it always go abroad to get new 'points'? Let it, rather, come to prove its ingenuity by original biological methods at home; then, with application of these at the sources of supply, — at the laboratory table, by the shores of the sea, by the river or the gulf, — we may solve those home problems which are most pressing. It is not too much to say that the eyes of the biologists of Europe are upon us and upon our material. Moreover, if, as is certain, the field is white for the harvest, need the reapers be few? or those few, Europeans?

And let us by no means forget our greatest opportunity. In the variety of our environments, and in the area of our country, we have conditions highly favorable for the study of those final broader physiological problems which must eventually be the key to life-science as a whole. We wish the new biological department every possible success.

THE ENEMIES AND PARASITES OF THE OYSTER, PAST AND PRESENT.

AMONG the worst enemies of the oyster of our Atlantic coast are the star-fishes; and great numbers of them are usually found upon all oyster-beds, where they are committing depredations upon the mollusks. It is an interesting fact, however, that the remains of star-fishes are rarely found in connection with fossil oysters of any age, not even with tertiary oysters. The oyster family culminated in the cretaceous period, as regards generic differentiation. The abundance of individuals was also as great then as it has ever been since; and it is often the case that the remains of oysters are found in great profusion in both cretaceous and tertiary strata. The cretaceous strata of Texas have furnished a great abundance of the Ostreidae of every generic and subgeneric form known upon this continent; and yet, among all the many collections of fossils from those rocks which I have examined, I have never seen a fragment of a star-fish, although echinoids in considerable variety are not uncommon.

Star-fishes very closely related to those now living upon our coast have been reported by Forbes from Jurassic strata, and I have recognized a similar form from the Neocomian of Brazil; but we have no evidence that star-fishes of any kind were ever a serious enemy to the oyster before the present epoch. The ancient star-fishes, no doubt, had the same propensities that their modern representatives have; but they seem not to have obtained that preponderance then which they have since acquired.

Burrowing sponges similar to, if not identical with, the living Cliona, are of very ancient origin. The fossil shells of the ostreid genera Exogyra and Gryphaea, as well as those of Ostrea proper, are as commonly and completely 'riddled' by burrowing sponges as are any shells of the living oyster. Indeed, it is rare to find even a small collection of fossil oyster-shells free from such burrows. Other fossil shells besides those of the Ostreidae are found to have been thus infested, the burrows being in all respects the same as those which infest the oysters.

Not only did Cliona exist abundantly with the Ostreidae of mesozoic time, but I have obtained evidence that it also existed in paleozoic time in essentially the same character that it has to-day. Several years ago I obtained from the Devonian strata of Iowa some shells of the brachiopod genus Strophomena, which contain numerous Cliona-like burrows. These I submitted to Prof. A. E. Verrill, who informed me that in his opinion they are the borings of a species of Cliona.

C. A. WHITE.

A MOUND OF THE KANAWHA VALLEY.

A mound recently opened by Col. P. W. Norris, one of the assistants of the Bureau of ethnology, presents some facts of more than ordinary interest. It is situated on the farm of Col. B. H. Smith, near Charleston, W. Va., is conical in form, about a hundred and seventy-five feet in diameter at the base, and thirty-five feet high. It appears, in fact, to be double; that is to say, it consists of two mounds, one built on the other, the lower or original one being twenty feet, and the upper fifteen feet, high.

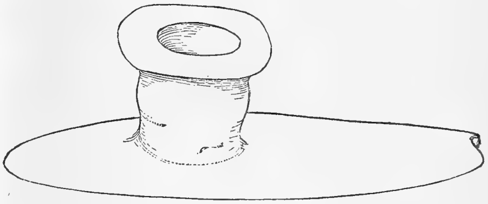
The exploration was made by sinking a shaft twelve feet square at the top, and narrowing gradually to six feet square at the bottom, down through the centre of the structure, to, and a short distance below, the original surface of the ground. After removing a slight covering of earth, an irregular mass of large, rough, flat sandstones, evidently brought from the bluffs half a mile distant, was encountered. Some of these sandstones were a good load for two ordinary men.

The removal of a wagon-load or so of these stones brought to light a stone vault seven feet long and four feet deep, in the bottom of which was found a large and much-decayed human skeleton, but wanting the head, which the most careful examination failed to discover. A single rough spear-head was the only accompanying article found in this vault. At the depth of six feet, in earth similar to that around the base of the mound, was found a second, also much-decayed, skeleton, an adult of ordinary size. At nine feet a third skeleton was encountered, in a mass of loose, dry earth, surrounded by the remains of a bark coffin. This was in a much better state of preservation than the other two. The skull, which was preserved, is of the compressed or 'flat-head' type.

For some three or four feet below this, the earth was found to be mixed with ashes. At this depth, in his downward progress, Col. Norris began to encounter the remains of what further excavation showed to have been a timber vault, about twelve feet square and seven or eight feet high. From the condition in which the remains of the cover were found, he concludes that this must have been roof-shaped, and, having become decayed, was crushed in by the weight of the addition made to the mound. Some of the walnut timbers of this vault were as much as twelve inches in diameter.

In this vault were found five skeletons, — one lying prostrate on the floor at the depth of nineteen feet from the top of the mound, and four others, which, from the positions in which they were found, were supposed to have been placed standing in the four corners. The first of these was discovered at the depth of fourteen feet, amid a commingled mass of earth and decaying bark and timbers, nearly erect, leaning against the wall, and surrounded by the remains of a bark coffin. All the bones, except those of the left fore-arm, were too far decayed to be saved: these were preserved by two very heavy copper bracelets which yet surrounded them.

The skeleton found lying in the middle of the floor of the vault was of unusually large size, "measuring seven feet six inches in length, and nineteen inches between the shoulder-sockets." It had also been enclosed in a wrapping or coffin of bark, remains of which were still distinctly visible. It lay upon the back, head east, legs together, and arms by the sides. There were *six* heavy bracelets on each wrist; four others were found under the head, which, together with a spear-point of black flint, were incased in a mass of mortar-like substance which had evidently been wrapped in some textile fabric. On the breast was a copper gorget. In each hand were three spear-heads of black flint, and others about the head, knees, and feet. Near the right hand were two hematite celts; and on the shoulder, three large and thick plates of mica. About the shoulders, waist, and thighs were numerous minute perforated shells and shell beads.



STEATITE PIPE FOUND NEAR CHARLESTON, W. VA.

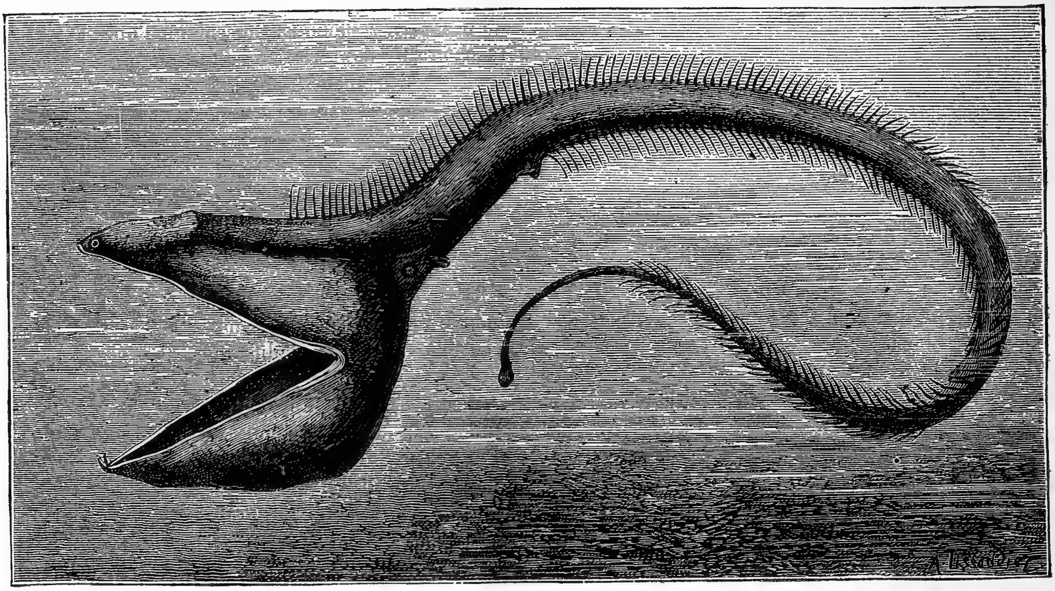
The gorget is precisely of the pattern represented in fig. 12, p. 100, Fifteenth report of the Peabody museum. The bracelets are very heavy, and, like the gorget, have the appearance of having been hammered out of native copper.

While filling up the shaft, Col. Norris discovered, in the dirt which had been removed from it, a steatite pipe, represented in the accompanying figure. It is worthy of note, that this pipe is precisely of the form of some found recently in the mounds of western North Carolina, and agrees exactly with the description, given by Adair, of pipes made by the Cherokees.

Cyrus Thomas.

THE ICHTHYOLOGICAL PECULIARITIES OF THE BASSALIAN FAUNA.[1]

THE author recalled the fact that he had recently proposed the name 'Bassalian realm' for the collective deep-sea faunas. At indefinite distances below the surface, deepest in the tropics, we find strange forms of animal life, which differ not only specifically and generically from those of the superincumbent water, as well as from those of the cold extremes of the globe, but often represent quite distinct families. Those forms which live at moderate depths (existing, as they do, in cold water) are related to, or even belong to, the polar faunas; but, as we go still deeper, we find various other assemblages of animals. Those of the lowest horizons are often wonderfully modified; and the deep-sea explorations of recent years have brought to light many very peculiar forms. Not the least remarkable of the several animal types, and in some respects the most remarkable, are the fishes. The only extended summary of our knowledge of the fishes of the deep sea has been given by Dr. Günther, in his 'Introduction to the study of fishes' (pp. 296–311). According to Dr. Günther, "before the voyage of H. M. S. Challenger, scarcely thirty deep-sea fishes were known. This number is now much increased by the discovery of many new species and genera; but, *singularly, no new types of families were discovered:* nothing but what might have been expected from our previous knowledge of this group of fishes" (p. 304). Dr. Günther evidently forgot that he had himself proposed to distinguish a peculiar family (Bathythrissidae) for a deep-sea fish obtained by the Challenger; and his generalization otherwise will not bear the test of confronting with the facts known even to him, much less those now known. In fact, the deep-sea fauna is surprisingly rich in peculiar forms of fishes; and no less than twenty-eight families are either confined entirely to the deep sea, or represented elsewhere by mere stragglers. Three new family types were obtained during the past year. Further, two orders, the Lyomeri and the Carencheli, are only known from deep-sea representatives. The families that have been already distinguished for the deep-loving fishes are twenty-eight in number.[2] Several of these have been



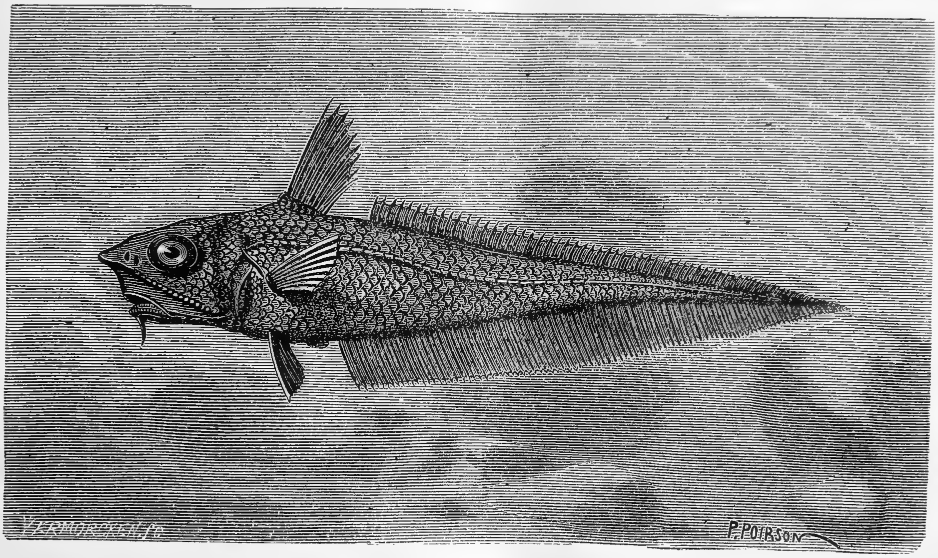
EURYPHARYNX PELECANOIDES.

[1] Abstract of a paper by Dr. THEODORE GILL, read to the National academy of sciences, April 17, 1884.

[The investigations carried on in connection with the French exploring-vessel Le Travailleur appear to confirm, as well as supplement, the results heretofore attained. Some of the new species have already been illustrated, and we here introduce figures of representatives of three of the most characteristic of the deep-sea types. These are Eurypharynx pelecanoides (the type of the family Eurypharyngidae and order Lyomeri), Macrurus australis (a form of the widely distributed and rich family Macruridae), and Melanocetus Johnsoni (a representative of the deep-sea pediculate family of Ceratiidae). Additional figures will be found in another article in this number. — ED.]

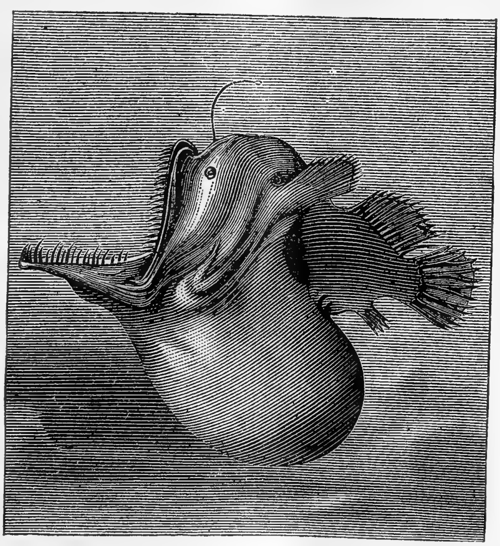
[2] Saccopharyngidae, Eurypharyngidae, Synaphobranchidae, Simenchelyidae, Nemichthyidae, Derichthyidae, Notacanthidae, Ipnopidae, Chauliodontidae, Stomiatidae, Paralepididae, Alepi-

greatly increased of late. Probably other families require to be differentiated for certain



MACRURUS AUSTRALIS.

peculiar forms; and, of course, numerous families, known from littoral fishes, have deep-sea representatives. It is obvious, then, that we have, in such an aggregate, a combination of forms very different from any of the superficial faunas we have heretofore considered. We will be justified, therefore, in recognizing for them a special realm, which has been called 'Bassalia' or the 'Bassalian realm.' But caution is timely that it seems to be rather a heterogeneous one, and may hereafter require restriction. The data now available are insufficient, however, for differentiating what are, doubtless, the several constituents or regions of this realm.


MELANOCETUS JOHNSONI.

Dr. Günther has even expressed the opinion, that (Introduction, p. 304), "as far as the observations go at present, no distinct bathymetrical regions which would be characterized by peculiar forms can be defined," and that, "if the vertical range of deep-sea fishes is actually as it appears from the Challenger lists, then there is no more distinct vertical than horizontal distribution of deep-sea fishes" (*op. cit.*, p. 305). There are reasons for believing that these generalizations are at least exaggerated; but it may be well to await the collection of more material, and the collation of more extensive data, before reversing them. Four factors must determine the bathymetrical distribution of fishes: (1) temperature, (2) the decrease and final absence of light, (3) the concomitant paucity or absence of vegetation, and (4) the pressure of the water. The relative importance of these several factors still remains to be studied, and their results discriminated. The absence of vegetable life confines the animal life to car-

sauridae, Alepocephalidae, Bathylagidae, Halosauridae, Bathythrissidae, Regalecidae, Trachypteridae, Lophotidae, Chiasmodontidae, Stephanoberycidae, Berycidae, Grammicolepididae, Polymixiidae, Lycodidae, Brotulidae, Macruridae, and Ceratiidae.

nivorous forms; and many of the fishes are pre-eminent for formidable armature, and some for extraordinary modifications for obtaining food.

SMITH SOUND, AND ITS EXPLORATION.

A MORE opportune moment could not have been selected by Dr. Bessels for publishing[1] a condensation of the literature relating to Smith Sound. Added to the interest which arctic narrative has always possessed, is the concern felt for Lieut. Greely and his party, and the hopes and fears awakened by the departure of the expedition for his relief. Many persons will therefore be glad to learn something of the region, which, with all its terrors and hardships, has been sufficiently attractive to again and again induce men to risk life and limb in the attempt to penetrate its mysteries. For that class of readers, Dr. Bessels' paper was, possibly, originally designed. But in relating the history of the more recent expeditions, especially those carried on under the auspices of the signal-office, the author has been so severe in his criticisms and reflections, that his production, while possessing the faults, has likewise the interest, of a polemic. Paragraphs like the following will certainly not fail in attracting attention for want of severity. "This plan, termed the Howgate plan, was devoid of all sound originality. The valuable parts of it are based on the work of Hayes and Weyprecht; the rest, emanating from the brain of Lieut. Henry W. Howgate, bears testimony that the originator of the '*Howgate plan*' was not familiar with even the rudiments of arctic exploration" (p. 414). "Lady Franklin Bay should have been the last place chosen as a permanent or temporary station" (p. 416). "That this plan [Howgate or Signal-service plan] would lead to disaster was pointed out by myself and others at an early date; but the judgment of the chief signal-officer in arctic matters was considered supreme, and upon him rests the responsibility of its failure. Several names connected with the signal-office will not easily be forgotten in arctic history" (p. 418). "The Proteus is now at the bottom of the sea; and all the arguments I could offer would not be able to raise her, or to relieve the ice-bound party in Lady Franklin Bay. The person responsible for the disaster is the chief signal-officer" (p. 435). "The preceding paragraph embodies the substance of his (Garlington's) instructions, as given and signed by W. B. Hazen, Brig. and Bvt. Maj. Gen'l, chief signal-officer, U. S. A." (p. 431). "It clearly shows that those who wrote Garlington's orders were utterly ignorant of the nature and character of the country to be traversed" (p. 436).

Other quotations might be made, which would show that the signal-service is not alone censured. The explorations of Sir John Ross and Hayes, and the conduct of Buddington, are all criticised more or less severely. Ross and Hayes are dead, and can make no reply; Buddington, according to Bessels, is not proficient in the art of writing, and we can expect nothing from him. But Gen. Hazen has a pen, which he has at times used with considerable effect; and it is possible that he may see fit to raise the low temperature of the present controversy to a height not at all in accordance with the normal of arctic literature.

But, on the whole, the strictures upon the signal-service expeditions appear to be just and proper. The folly of intrusting the organization and details of an arctic exploring-party to a board composed of persons without special experience, has been forcibly brought to notice by the failure of both relief expeditions; and possibly it will be made more prominent when we know more of Lieut. Greely's situation and experiences. That such a board should advise many unwise things, and propose schemes and plans more or less impracticable, was in the nature of things. But that success should be expected from nautical expeditions to the polar seas, which were commanded by persons not only without arctic experience, but ignorant of the art of navigation and the management of ships, seems incredible. Certainly Greely's party, as well as those undertaking his relief, should have had the benefit of the best arctic and nautical experience, assistance, and advice. That they did not have it is evidently the fault of the originators of the Lady Franklin Bay plan, and the devisers of the details of its execution.

But, while careful to point out the errors in origination and execution of the signal-service expeditions, Dr. Bessels appears to entirely overlook the fact that the Polaris expedition, of which he was a member, was so constituted as to invite, if not insure, failure. Hall, its commander, though of great arctic experience, was entirely ignorant of ships, their management, navigation, and capabilities. He was also entirely an uncultivated man, and little fitted to observe or study phenomena in their scientific aspects. His sole qualification for the direction of a polar expedition was his enthusiasm and interest in arctic exploration. To supply his deficiencies, the Polaris party was peculiarly organized. The care and management of the ship were in the hands of Buddington. The scientific corps was under the direction of Dr. Bessels. Hall was to supply the steam necessary to run this rather complicated machinery. Naturally, from such an organization, continual controversy was to be expected; and controversy, under the circumstances, would necessarily seriously affect the success of the undertaking. But the instructions issued by the Navy department provided, that, in case of Hall's death, the control of future operations should be shared by Buddington and Bessels; the former being supreme as far as the vessel was concerned, the latter equally supreme in the direction of matters on shore. Such a provision could but tend to a failure in all respects. During Hall's life the possibilities were, that either scientific observations would be sacrificed to the supposed interests of the vessel, or that the real interests and safety of the vessel would be sacrificed to a supposed necessity for

[1] Proceedings of the U. S. naval institute, vol. x., no. 3.

making additional scientific observations. The most likely course to be pursued would be the subordination of both science and safety to Hall's dominant motive, — the desire to reach a high latitude. In the event of his death, the foregoing possibilities would become probabilities, if not actual certainties. It should never be forgotten, when attempting to determine the relative values of the organizations of the several polar expeditions, that the success of the Polaris was entirely due to unprecedented good fortune, and not at all to good management, or extraordinary judgment in encountering and overcoming obstacles. Had serious difficulties occurred at the outset, for instance such as the English expedition had to contend with, it is probable that geographical knowledge would not have been advanced to any important extent.

The principal defect to be noticed in Dr. Bessels' paper is a want of appreciation of the laws of literary and historical perspective. Quite unconsciously, perhaps, he exaggerates the importance of events with which he was personally associated. As an instance, the narrative of the Polaris' voyage is detailed at extraordinary length, occupying some thirty pages of the paper; while the history of the late English expedition, by far the most important of all, occupies but fourteen pages. In fact, an ice-hummock seen by the Polaris appears to be of more consequence than an iceberg seen from any one vessel; and an oath of Buddington's more worthy of chronicle than the most animated descriptions of Kane, Hayes, or Nares. This is a very serious fault in an historical writer, and cannot be too severely reprehended. Generally speaking, it tends to render the style of the publication undignified, and the substance trivial. But it is only fair to remember that Dr. Bessels is writing of circumstances of an exceptional nature; that he is relating much that is new, and which to most persons is rather secret than general history; that he was intimately and prominently connected with the events of which he writes; and that the facts have not, heretofore, been presented from his particular point of view. The faults of the paper are therefore excusable, while the merits would counterbalance them even were they not. The history of two hundred and sixty years of arctic exploration, so far as it relates to Smith Sound, has been condensed into a volume of a hundred and fifteen pages, accessible to any one. The voyages of the various discoverers, beginning with Baffin and Bylot, and ending with Garlington, have been analyzed with a care that indicates the expenditure of considerable labor. The result will be a better appreciation of the work of the older navigators, which Dr. Bessels shows to have been more accurate than was to be expected, and strongly contrasting with that of some of their successors, notably Dr. Hayes. Indeed, considering the light thrown on the geography of this region by the observations of the Polaris, Nares, and Proteus expeditions, it is very difficult to understand how Dr. Hayes could have asserted the existence of the open polar sea. But Dr. Bessels has shown how it was possible for the mistake to be made. In his opinion, and he brings strong evidence to support it, Hayes never reached a latitude above 80°. If this be true, then we can understand why Hayes, looking, as he must have done, across Kane's basin, should have imagined that he saw an open sea. No other plausible explanation can be given; for, had he been north of Cape Collinson with an atmosphere sufficiently clear for observations, he could not have failed to see the opposite coast of Greenland, only thirty miles distant.

In discussing the scientific results, Dr. Bessels might have gone more into detail without fear of incurring displeasure, for the scientific results are the most valuable products of the various arctic expeditions. He is of the opinion that the general set of the currents is to the southward, and that there are no data supporting the theory of an extension of the Gulf Stream to these high latitudes. He calls attention to the fact that the ice met by the Polaris was of a different character from that encountered by the English expedition, and points out the causes which would prevent the latter formation from being continuous. He says, "There is no reason to assume that the ice-cover of the sea in close vicinity to the north pole should be more dense and impenetrable than its lower latitudes." He is also of the opinion that land in some shape exists to the northward of Markham's highest position, basing his opinion upon the soundings and character of the ice in that latitude. This latter assumption may or may not be true; but it will not, in all probability, be removed from the domain of hypothesis for some time to come.

Finally, Dr. Bessels does not consider Greely's situation as dangerous, and is of the opinion that the party remained at Lady Franklin Bay during the past winter, and will be found in the vicinity of Littleton Island about the end of June. He adds some advice regarding the conduct of the relief expedition, which appears judicious; and, considering the experience of the author, it should have great weight.

The impression left after reading the paper, while not exactly prejudicial to arctic expeditions, is certainly opposed to them as some have been heretofore constituted. Their value really lies in the opportunity they afford scientific observers to study phenomena out of the usual range. Unfortunately this end has always been subordinated to a desire to reach the north pole, or an effort to rescue those who had gone forth on that rather barren quest. Without doubt, had not most arctic expeditions been animated by those dominant motives, the results would have been of far more consequence. Certainly future expeditions should be guarded against the operation of similar influences.

THE DEEP-SEA FISHES COLLECTED BY THE TALISMAN.[1]

In the cruises made by the Travailleur, the exploring-instruments left much to desire, and the taking of fish was so rare, that, as Mr. Milne-Edwards said

[1] Translated from an article by H. Filhol in *La Nature*.

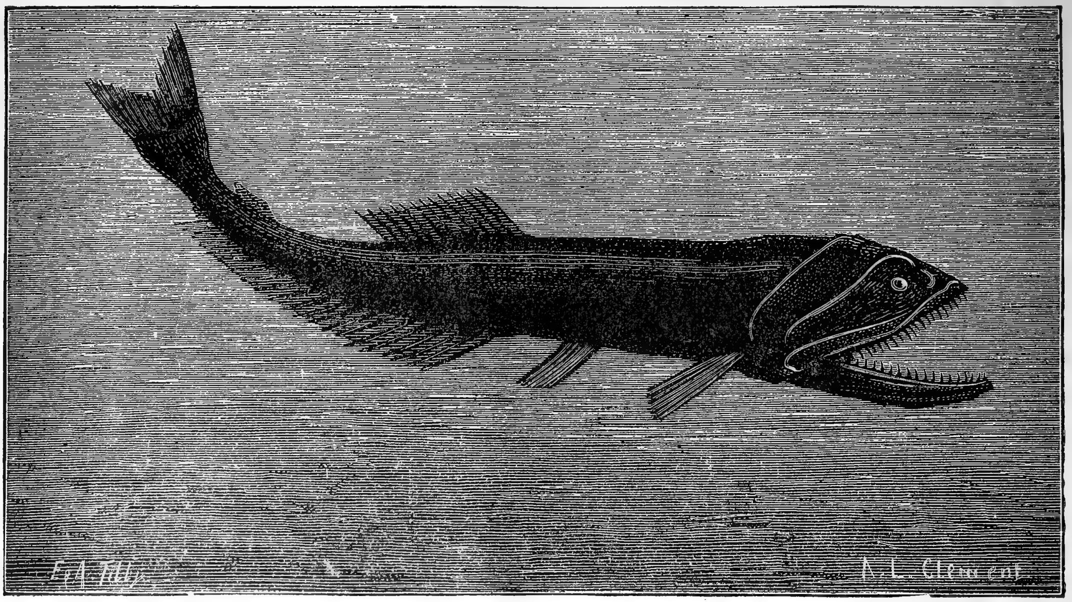


FIG. 1.—NEOSTOMA BATHYPHILUM.

in his report, the capture of one of these creatures 'was considered really an event.' During the cruise of the Talisman, thanks to that new invention, the trawl, they were taken more frequently. Almost all the dredgings resulted in the capture of some fish, and sometimes the number brought up was surprising. For instance: on the 29th of July, in latitude 16° 52′, longitude 27° 30′, in one drag of the trawl, 1,031 fishes were taken, at a depth of 450 metres.

The most interesting surface fishes taken were a large shark, and a fish of small size peculiar to the Sargasso Sea, Antennarius marmoratus Bl. Sch. Sharks (Carcharias glaucus) were found especially between Senegal and the Cape Verde Islands. They followed our ship in schools, and we often saw them accompanied by their 'pilots,'—fishes known among the ancients as Pompilius, and, by naturalists of the present time, as Naucrates ductor. It seems that Naucrates acts as a guide for the sharks, and that the latter, in recognition of its services, never pursue it. It is certain that the Naucrates which we saw lived in perfect harmony with the sharks. They swam around them, and sometimes leaned against them, within the pectoral fin. These fishes, which much resemble mackerel, are bluish gray, darkening toward the back; broad vertical stripes of a beautiful blue encircle their bodies; the pectoral fins are white, the ventral ones black, while the tail is of a blue shade. We found this species of shark in the Sargasso Sea.

In the midst of the floating vegetation of the Sargasso Sea, the second species peculiar to the surface-water, noticed at the beginning of this article, Antennarius marmoratus, is one of the strangest animals we observed. Its back is furnished with long appendages; and its fins, elongated and broadened at the ends, and digitated, form a sort of feet by means of which it circulates among the seaweed which shelters it. It builds a nest, joining, by means of strong mucous threads, balls of the seaweed on which it deposits its eggs. These balls float, tossed about by the waves; and, when the young are born, they probably find a safe home within. This fish, like all the animals of the Sargasso Sea, crustaceans and mollusks, is of the same color as the Algae: it has, as it were, assumed their livery. The color of the body, spotted with brown and yellow and white, harmonizes perfectly with the surroundings; and it is only by careful scrutiny that it is discovered. It is evident that this similarity in color is to allow the animals easily to conceal themselves, and thus escape their enemies. But, as Mr. Milne Edwards observes, if this livery is a protection to the animals possessing it, it becomes in certain cases a danger for them; for, owing to it, the carnivorous species which have assumed it can very easily approach their prey without fear of being seen.

The fishes from the deep sea taken on board of the Talisman include a considerable number of genera and species. An examination of them discloses a series of general facts of great interest. The first question which is suggested to one who studies them is this: are there genera and species of fishes characteristic of bottoms of certain depths? that is, are different faunas found at one, two, three, four, and five thousand metres? This question may be answered in the affirmative, for the dredgings show that the distribution of certain forms is limited. Many examinations were necessary to reach this conclusion, on account of the strange circumstance that certain species are found at a depth of from 600 to

almost 3,000 metres. Thus a fish showing the same organic structure is capable of living under pressures varying from a half-ton to one and two tons, and even more. It may be asked how it is that there are forms characteristic of certain depths; for, with zones of distribution of so great extent, it would seem that abyssal faunas should remain the same. The explanation of this singular fact is, that fishes which are found at a depth of from 600 to 3,600 metres do not dwell continuously in the same locality: they are travellers, rising and descending in turns into the abysses of the sea; and, when they make these journeys, they go slowly, so that they can endure the slow expansion and contraction. I will notice a few species which have made known to us these wonderful voyages. We found Alepocephalus rostratus between 868 and 3,650 metres, Scopelus maderensis between 1,090 and 3,655 metres, Lepioderma macrops between 1,153 and 3,655 metres, Macrurus affinis between 590 and 2,220 metres; the depth of distribution for these four species varying by 2,782, 2,561, 2,502, and 2,000 metres. I could mention other cases, but those cited will suffice to show that the organization of fishes of certain depths is such that it is capable of sustaining enormous weights without suffering. The structures of the fishes just mentioned have nothing special which attracts attention, and distinguishes them from fishes living near the surface. Their teeth are well developed, this peculiarity showing that they are carnivorous (fig. 1). All fishes which live continuously at a depth greater than 600 metres are carnivorous. This results from the fact, that, with the absence of light, vegetation quickly disappears at the bottom, and consequently all the species which do not rise to within 150 metres of the surface, the point where the last Algae are found, are obliged to hunt for food. Fig. 2 shows a cut of one of these fishes, Macrurus globiceps, whose depth of distribution is between 1,400 and 3,000 metres.

If the fishes which transiently visit great depths do not show peculiarities in form, this is not the case with those which continuously inhabit deep waters. This ought not to surprise us, for the structure of these animals must suffer important modifications before being adapted to these peculiar conditions of life. Various influences act upon these fishes. Light and vegetation are wanting. Beyond a certain depth the temperature of the surrounding water tends to become equalized, and the water in which they live is always calm. The modifications due to these circumstances affect the structure of the tissues, the size of the eyes, the development of the sense of touch, and the color. Moreover, these fishes possess organs which ordinary fishes do not possess. Their function is to emit phosphorescent light, and thus to supply the light which is lacking.

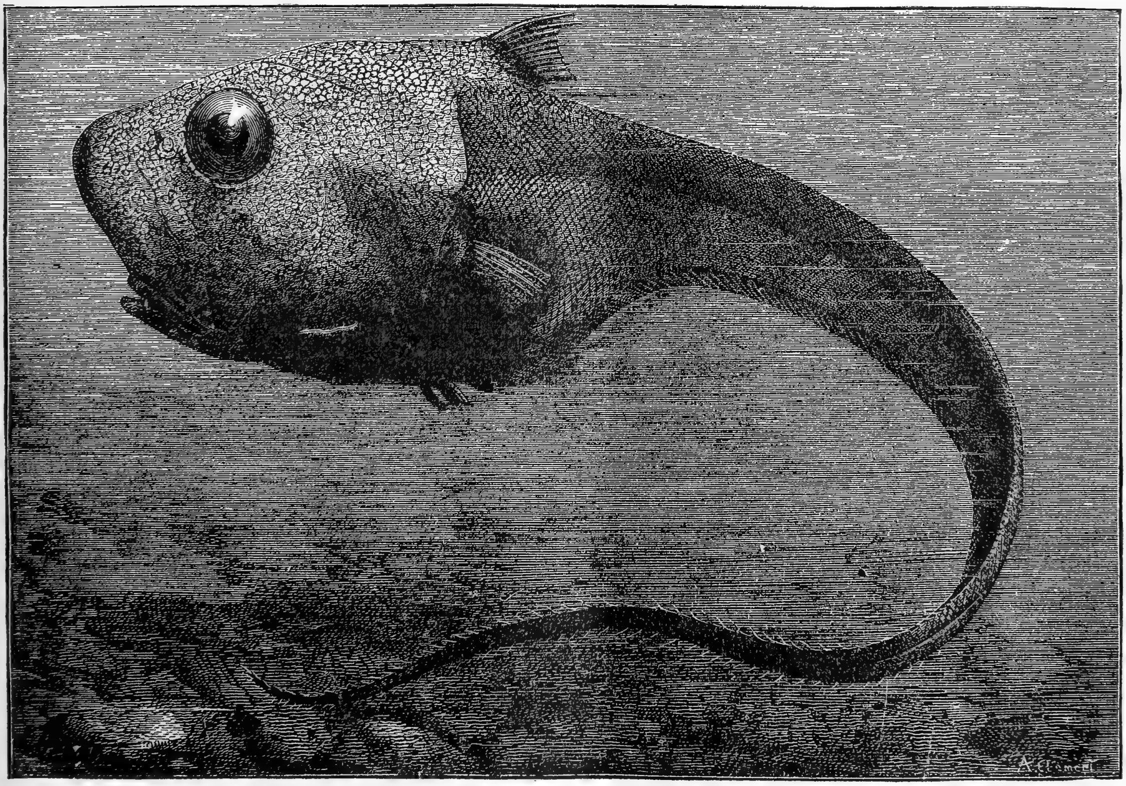


Fig. 2. — Macrurus globiceps.

The changes undergone by the tissues are seen in the structure of the skin, muscles, and bones. The skin is thin, and destitute of bright colors, the shades varying from grayish to velvet black (fig. 3). The scales, often much reduced in size, are weakly attached, and the friction which they experience during the ascent of the trawl removes almost all of them. The muscles have little resistance, and, being without flavor, the fish are not edible. The bones are friable, and spongy inside.

In fishes living continuously at a depth to which a little light penetrates, the eyes are quite large in order to present a larger sensitive surface. This fact recalls what we notice in crepuscular birds, whose visual organs are also much developed. Among fishes at a great depth, this increase of the size of the eye is not observed. These organs are of normal size, and possess nothing peculiar, either in their position or structure. Their function in absolute darkness seems at first almost incomprehensible. When, however, one recognizes the fact that these animals possess phosphorescent plates, or, rather, that they are covered by a luminous mucous coating capable of lighting a considerable space, the explanation is found. This phosphorescence serves partly to guide them, and partly to attract prey. It serves, in the latter case, the same purpose as a torch in the hand of a fisherman. This fact has been verified, long since, in the case of surface fishes which hunt at night. Thus Bennett describes a species of shark remarkable for a bright green phosphorescence, which is emitted from the whole lower portion of its body. This learned zoölogist one day brought one of these fishes into a dark room, which was immediately illuminated by its body. The light is increased neither by motion nor by rubbing. After the shark's death, the light from the stomach first disappeared. The jaws and the fins were the last to retain the phosphorescence. The various sharks found only at a depth of two thousand metres, of which several specimens were taken by the Talisman off the coast of Portugal, must, like the fish of which Bennett spoke, use the light which they emit to attract the fishes on which they feed. What is the origin of this mucous coating, which is thus able to shed so bright light? It must be due to the existence of glandular organs, scattered along the sides and the tail, near the eyes on the head, and sometimes more sparsely on the back. But, besides these glandular follicles, certain fishes have apparatus of a quite different kind, which emits light. These organs consist of a sort of biconvex transparent lens, closing externally a chamber filled with transparent liquid. This chamber is furnished with a membrane of black color, formed of

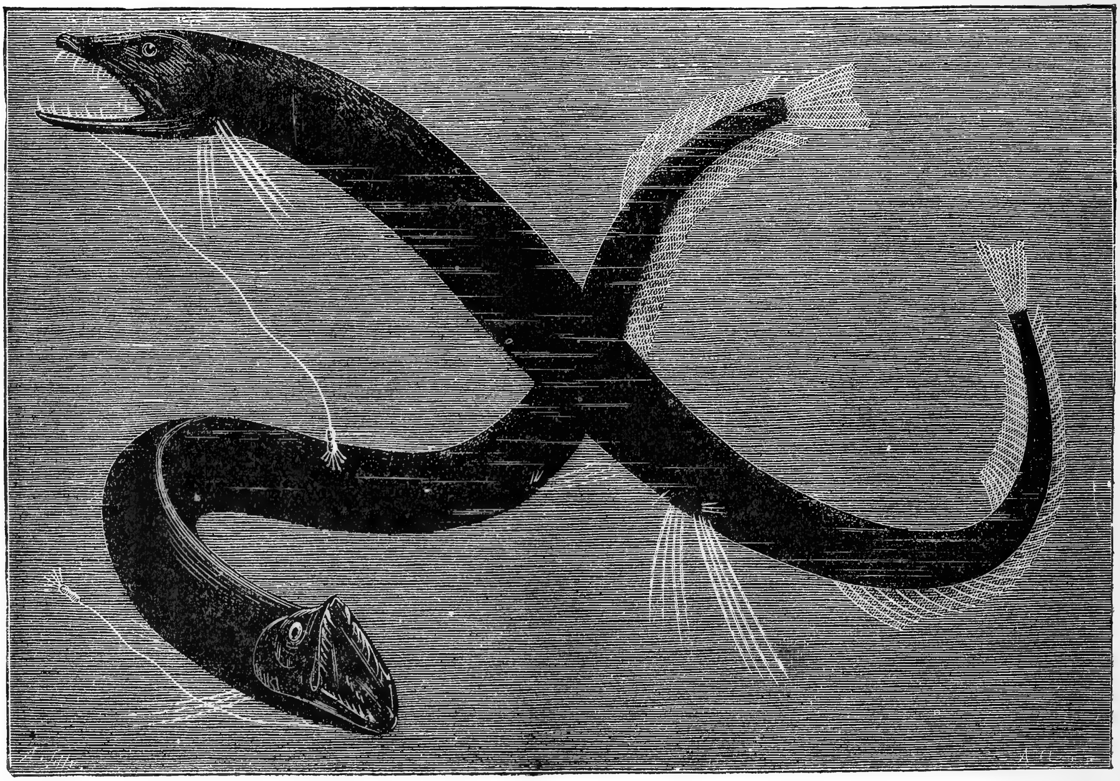


FIG. 3.—EUSTOMIAS OBSCURUS.

little hexagonal cells, much resembling the retina: it is connected with the nerves. These phosphorescent plates are placed either below the eyes, or on the sides of the body. In the Talisman exhibition-rooms, Malacosteus niger (fig. 4) may be seen, caught 1,500 and 2,000 metres below the surface, with enormous plates below the eyes, and Stomias, found at the same depth, with side-plates. Several zoölogists have considered the last-mentioned organs as secondary eyes, in consequence of the retina-like membrane which covers them, and on account of its connection with the nerves. This view is difficult to admit, when the normal development of the eyes is taken into account; and it seems much more reasonable to suppose that they serve simply to produce light, which, owing to the lens in front, may be brought to a focus at a certain point.

The tentacle, which is in continual motion, serves as bait to attract fishes on which it springs. Other very peculiar transformations of the rays of the fins into organs of touch may be seen in various fishes taken on board the Talisman. Bathypterois is especially worthy of mention. Among the most singular tactile organs we noticed in these fishes, that of Eustomias obscurus, immediately below the mouth, is to be mentioned. This new genus is shown in fig. 3. One of the most remarkable peculiarities of fishes living in very deep water is the great development of the mouth and the stomach. In Melanocetus and Chiasmodus, the capacity of the latter organ is such that it can contain prey whose size is double that of the body of the fish. As to the proportions assumed by the mouth, the greatest development is shown by Eurypharynx pelecanoides (see figure, p. 620).

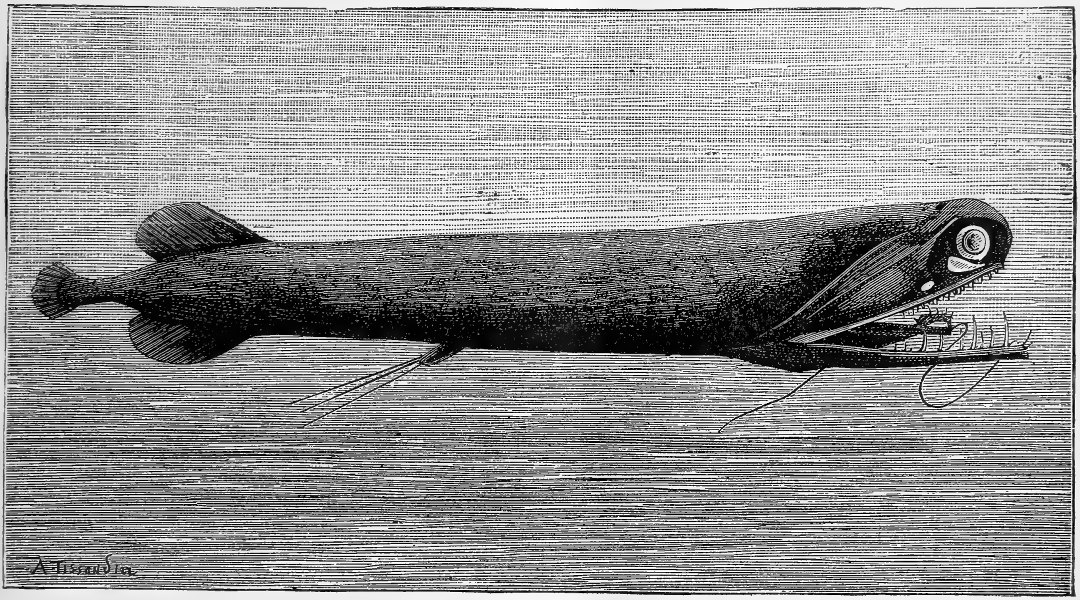


FIG. 4.—MALACOSTEUS NIGER.

Fishes at a great depth seem to move very little. They evidently live buried in the ooze, for one invariably notices bits of lime on their bodies. Often several fin-rays, instead of performing their usual duty, become organs of touch. One of the most remarkable examples of this is shown by a fish caught on the coast of Africa, the Melanocetus Johnsoni (see figure, p. 621). In this animal, which was known only by a single specimen found dead on the surface near Madeira, the first ray of the dorsal fin was developed, and formed a forward projecting true organ of touch, serving the same purpose as that of the goose-fish. In the latter fish there also exists a tentacle at the extremity of the first ray of the dorsal fin. The goose-fish lives in the sand, or ooze, where, by means of its fins, it makes a cavity in which it entombs itself, thrusting out only the upper part of its body.

One of the most interesting questions concerning the distribution of fish relates to the maximum depth at which these animals are met. On the Talisman, the fish caught at the greatest depth was Bythites crassus: it was brought up from a depth of 4,255 metres. The Challenger obtained a fish, Bathyophis ferox, at 5,019 metres.

[Mr. T. H. Bean, curator of fishes in the U. S. national museum, has furnished the following notes on the fishes obtained at the greatest depth by the Albatross, in a letter addressed to Professor Baird, and kindly placed by him at our disposal.—ED.]

The greatest depth explored by the Albatross was 2,949 fathoms (5,394 metres), which was found Oct. 2, 1883, in north latitude 37° 12′ 20″, and west longitude 69° 39′. Five species of fishes, representing

as many distinct families, were obtained in this haul. They are the following: Cyclothone lusca Goode and Bean, Scopelus Mülleri Gmel., ? Aleposomus Copei Gill, an undescribed alepocephalid with scaleless body and head, Mancalias uranoscopus Murray, and Plectropomus crassiceps Goode and Bean MS.

The species obtained at the greatest depth by the Challenger was Gonostoma microdon Günther, which was obtained by the trawl from 2,900 fathoms (5,304 metres), in north latitude 35° 22′, and east longitude 169° 53′.

There may be reason to doubt, with Dr. Günther, the pertinence of Gonostoma microdon to this extreme depth; and the same may be said of our very closely related Cyclothone lusca (a species which is at least congeneric with G. microdon), especially as we have it from depths varying between 552 and 5,394 metres; and it is abundant and widely distributed in the lesser depths. Scopelus Mülleri, also, has been obtained in 556 metres. As for ? Aleposomus and Mancalias (and perhaps, also, Plectropomus), there can be no doubt that they are true deep-sea fishes; and we may expect to find them frequently at the great depth of 5,400 metres. Mancalias uranoscopus Murray was taken at a depth of 4,390 metres by the Challenger, in the Atlantic, between Canary and Cape Verde Islands. The Albatross specimen of this species is the type of Dr. Gill's supposed new blind ceratiid genus, Typhlopsaras.

JOURNEY OF LESSAR TO SERAKS.

THE military railway from Michel Bay, on the Caspian, to Kisil Arvat, was finished in September, 1882. It was afterward decided to make a preliminary survey, having in view the extension of this road to Seraks. The expedition comprised twenty Cossacks, ten sappers, two surveyors, two interpreters, and a guide, who set out from Askabad, a newly established station. In October they reached Annan, after crossing a flat country broken here and there by sandy hills some two thousand feet in height. Annan contains an immense mosque in a half-ruined condition, but with its principal façade intact, and of remarkable elegance. It is the finest of the few monuments of art in the Tekke country. The people live mostly in khibitkas: the site of the town is surrounded with ruined fortifications. Thence the route passed between the dunes twenty versts, to Gwiwars, which has three series of dilapidated fortifications inhabited by a few Kirgis and Tekkes. Several caravans of Tekkes were met with on their way from Merv to Akhala. Having taken refuge in the Merv oasis during the war, they were now expelled by the Mervli, who feared famine from the presence of too many people. The distance from Gwiwars to Baba Durmaz was found to be thirty-six versts, over an undulating country. Water is conveyed to Durmaz by a canal, and, though a little salt, is used by men and beasts without inconvenience. The chiefs of Khorassan, enraged by the conquest of Akhala, and discontented at the reign of order established by Russia on the steppes, are in general unfriendly. The population, however, are well satisfied, and enjoy a peace which they have never known. They are no longer raided by the Mervli, and many men formerly enslaved at Khiva or Akhala have returned to their villages in freedom due to the Russian conquest. From Durmaz to Liutfabad the forests have been cut away, and the soil is riddled so by the burrows of porcupines, that men and horses stumble at every step. Here and there are hillocks surmounted by ruins of towers or ramparts. Very lately each village or farm of this country possessed a round tower, with a single entrance closed by an enormous stone, to which the inhabitants retired at a moment's notice of the approach of one of the robber-bands who infested the region. The robbers did not attack the tower, but stole or destroyed every thing outside of it. At present a watch is rarely kept, and the towers are falling into decay. Liutfabad has a bazaar, reputed the best in all that country, where, however, the only goods were sugar, dry raisins, rice, nuts, bad tea, and henna. The inhabitants held the kindest relations with the Russian explorers. Thence to Kaakha the country for thirty versts is fertile, well watered, with a numerous population; but the streams are destitute of bridges. Woods were observed toward the mountains north of the route.

Near Kaakha the uniformity of the plain is broken by villages, fortifications, and numerous tumuli generally on the banks of streams. These last were said by Vambéry to be erected by the Tekkes over the graves of their chiefs; but the people deny this, and there is little doubt that they are prehistoric. They are circular or elliptical, and reach fifteen or twenty metres in height. Along the route the people worked in the fields with horses or camels, and did not avoid the Russians, but met them on friendly terms. The approach of the party constantly started up pheasants, partridges, and other game from the fields. The Tekke *cuisine*, observed by the explorers, did not comprise the revolting dishes reported by Vambéry, but included pilau, game, camel's milk, melons, and pastry. The people eat with their fingers, but have wooden spoons. On all the steppes many termite-hills were visible, hemispherical, a foot and a half high, and two feet in diameter. These insects are amber-colored, and half an inch long: they form a covered way to any object which they desire to consume, especially wood or cloth. Though destructive to wooden buildings along the line, they have not injured the sleepers of the railway, which is ascribed to the jarring motion produced by the passage of trains, which is supposed to destroy their mud-tunnels, outside of which they will not work.

Seraks is a rather large fortress occupied by a battalion of Persian infantry. The outer line of works is extended to include farms and vineyards. The environs are habitually pillaged by Tekke robbers, who inspire such fear that the garrison never ventures on a *sortie*, and dares not attempt to succor a caravan attacked within a mile or two of the ramparts; and at night the patrol always carry torches. The fortress is armed with six old useless cannon. The River

Tejent passes near Seraks, but is generally dry: its bed is about half a mile wide. The water from the melting snows and heavy rains is retained in large reservoirs closed by sluices, and distributed by canals for irrigation. Wells reach water at a depth of twenty feet.

The levelling carried on by the party has demonstrated, that, in leaving the Caspian Sea, there is not a general rise of the surface. At the wells of Aydine, several points are notably lower than the surface of the Caspian; and the whole region between the latter and the wells is a dried up arm of the sea. The aspect of the observations leads one to believe that they will show, when worked up, that there are many points in the sandy deserts between the Tekke oasis and Khiva which are lower than the Caspian; and it is already certain that the alleged former junction of the Tejent and Murial Rivers with the Oxus was an impossibility, and that, though nearer to each other, they emptied directly into the Caspian. Further work will be necessary to show the exact origin of the depressions met with in different parts of the steppes, and which have been taken for beds of ancient water-courses.

The expedition terminated its work at Seraks, and returned to Askabad by a different route.

PALMS.

SOME interesting details respecting these princes of the vegetable kingdom, as Linnaeus called them, are to be found in Sir Joseph Hooker's last report on the progress and condition of the Royal gardens at Kew. The extent to which they have recently been brought into cultivation is noteworthy.

Miller, in his Gardener's dictionary, edition of 1731, knew of seven species; but only two were generally known in conservatories, — the dwarf fan-palm of the south of Europe, and the date. Aiton's Hortus Kewensis, in the second edition (1813), enumerates only 24 species. The Loddiges, great cultivators of palms, who possessed in their day much the largest collection known, enumerate 210 species in their nursery catalogue of the year 1825. In the Herrenhausen conservatories, Hannover, Wendland had assembled 287 species in 1835, and 445 in 1882. This is the largest collection in the world; but the noblest must be that of the Botanical gardens of Buitenzorg, Java, which, in 1860, boasted of 273 species, 'all standing naked in the open air.'

It is only when the literature of the order is brought together systematically, that we appreciate the extent and the variety of palms. In the new Genera plantarum, Sir Joseph Hooker characterizes 132 genera of true palms, and indicates about 1,100 species.

Our readers may like to know what palms are indigenous to the United States, and what names they now bear. Without counting one or two tropical species which grow in southern Florida, and which are outlying Cuban and Bahaman species, we have two true palmettos, Sabal palmetto, and S. Adansoni; the blue palmetto, Rhapidophyllum hystrix of Wendland; the saw palmetto, Serenoa serrulata of Hooker. This is the old Sabal serrulata, upon which Hooker has recently founded a new genus, dedicating it to our associate, Sereno Watson (*Palmam qui meruit ferat*), there being already a Watsonia in honor of an earlier botanist of this name. Finally we have, just beyond our national borders, namely, on the islands off Lower California, a palm of a peculiar genus, instituted by Mr. Sereno Watson, the Erythea edulis; and in southern California the elegant Washingtonia bilifera, with which Wendland has complimented our country by naming this palm in honor of its first president. The only other president so distinguished is Jefferson. Jeffersonia diphylla is one of our choicest spring flowers.

THE DEARBORN OBSERVATORY.

THE report of Prof. G. W. Hough, the director of the Dearborn observatory, to the board of directors of the Chicago astronomical society, exhibits an encouraging state of activity in that establishment. The eighteen-inch equatorial and the Repsold meridian circle have been kept in excellent order and in constant use; though it does not appear, from the report, that this latter instrument has been employed in any service where a smaller and less adequately equipped instrument would not equally have sufficed. The objects specially studied with the great telescope were the great comet of 1882, difficult double stars, and the planet Jupiter, in addition to which a few miscellaneous observations were made. The comet-observations are of interest as throwing some light on the question of the breaking-up of this body into three separate and distinct fragments, and the testimony of so powerful a glass is of high importance. Professor Hough's observations, from Oct. 5, 1882, to March 6, 1883, are all consistent with regard to the apparent separation of these three centres of condensation; but they were all the time connected by matter of less density, so that no complete separation took place between the parts of the head.

Sixty-six new double stars were discovered during the year, most of which are difficult objects, and can be measured only when the seeing is good. Professor Hough estimates that not more than one observing night in three is suitable for such observations. In the search for D'Arrest's comet, six new nebulae were detected, three of which were found by Mr. Burnham. The companion to Sirius was measured on a goodly number of nights by both these observers. Professor Hough expects this object to be, in a few years, entirely beyond the reach of all telescopes except the largest ones, as the distance between the components (now nine seconds of arc) is diminishing about three-tenths of a second annually.

The great red spot on the planet Jupiter, first noticed in 1878, and which has been, until the past year, of a reddish-brick color, has gradually grown paler, until, at the present time, it is barely visible. Professor Hough ventures the opinion that it cannot be seen much longer in any telescope. Its stability has been remarkable, not having changed very ma-

terially in length, breadth, outline, or latitude, during four years' time. A slow retrograde drift in longitude has, however, taken place quite uniformly. The summary of mean results of Professor Hough's micrometric measures of the spot is as follows: —

	1879.	1880.	1881.	1882.
Length	12.25″	11.55″	11.30″	11.83″
Breadth	3.46	3.54	3.66	3.65
Latitude	−6.95	−7.14	−7.40	−7.52

While the spot has remained thus nearly stationary in latitude, the south edge of the great equatorial belt has gradually drifted south during the late opposition, until it is nearly co-incident with the middle of the spot. But, what is remarkable, the two do not blend together, but are entirely distinct and separate, seeming thus to indicate that they are composed of matter having repellent properties, similar to two clouds charged with the same kind of electricity.

In the years 1664, 1665, 1666, a great spot, with a diameter of some eight thousand miles, or about one-tenth that of Jupiter, was observed by Hook and Cassini, and situate in latitude 6″ south of the planet's equator. The spot re-appeared and vanished eight times between 1665 and 1708, was invisible from this latter year until 1713, and the longest period of its continuous visibility was three years, and of its disappearing, five. Professor Hough suggests the possible identity of that great spot with the present one, taking much the same ground with Russell of Sydney, — that it is a portion of the solid body of the planet, or *Jupiter firmus*, so to say, and is ofttimes rendered invisible by a covering of clouds. Professor Hough does well to call attention to the incorrect statement, so universally made in the astronomical text-books, that new belts are formed on the disk of the planet in the course of a few hours' time. The appearance of the disk changes from hour to hour, owing to the rapid axial rotation of the planet; and, as we pass from the equator to the poles, the apparent transit of an object across the disk becomes slower and slower. Observers, even at the present time, not always realizing that they are looking at a globe, and not at a plane surface, make statements regarding rapid changes in size or shape of objects on the planet's disk that are not legitimate deductions from the actual observations.

Regarding other configurations of the disk of Jupiter, Professor Hough notes the drifting south of the great equatorial belt nearly two seconds of arc during the late opposition. Small oval white spots were observed to be quite numerous. They were difficult to observe, and their identification is somewhat uncertain; but they appear to have a general retrograde drift at the rate of seventy miles per hour. Great numbers of minute white spots and markings near the equatorial regions were also observed, the discussion of which is reserved; but it is a curious fact that these spots should drift for years with the enormous velocity of two hundred and sixty miles per hour, if they are nothing more than clouds in the planets' atmosphere. The series of micrometric measurements on all these belts and spots appears to have been sufficiently elaborate, and the results derivable from a complete discussion of them will surely possess much of interest. Four sketches accompany the report, which show the salient features of the disk merely, no attempt having been made to represent the minute detail of the equatorial markings.

About the average success is reported in the contact-observations of the transit of Venus, of December, 1882. Mr. Burnham assisted in taking a number of dry-plate photographs of the planet on the sun, which present very sharp outlines of the disks of the sun and Venus. The method of insuring a minimum exposure, ordinarily in use by photographers, was employed; the equivalent exposure for any part of the sun's disk being as short as one sixteen-hundredth part of a second. Professor Hough regards these experiments as showing conclusively that astronomical photography will be most successful when the time of exposure becomes a minimum.

DAVID P. TODD.

A NEW MOTOR.

THE pneumatic tramway engine company of New York has recently issued a prospectus, in which it presents the claims of compressed air as a motor for short lines, with statements of the results of experiments with a motor built for them by the Baldwin locomotive-works. The engine was used, experimentally, on the Second-Avenue elevated railroad in New-York City, with what would seem to have been very satisfactory results.

The locomotive has four driving-wheels, two working cylinders of twelve inches and a half diameter and eighteen inches stroke of piston, with running-gear like that of the standard steam-locomotive of small power. In place of the boiler there are four air-reservoirs, each three feet in diameter, of Otis steel, half an inch thick, having a tenacity of seventy-five thousand pounds per square inch of section, and made up with the spiral seam introduced by Root. These reservoirs are tested to eight hundred pounds per square inch, and are filled with air at six hundred pounds. A small steam-boiler inside the cab is used as an air-heater, and raises the temperature of the air leaving the reservoirs, and on its way to the cylinders, to about 240° F. A reducing-valve causes the pressure to fall, at the cylinders, to a hundred pounds per square inch, the working-pressure for the engine. The cylinders are lubricated in part by the water taken up in the heater, where the air bubbles up through the confined liquid, and in part by oil, introduced for that purpose. The main valve is worked in full gear, and expansion is obtained by the use of an independent 'cut-off valve' on its back.

The 'braking system' is as novel as it is ingenious and effective. The engines are reversed, as in the method of Le Chatellier; and they thus become pumps, taking in air, which is forced into the main reservoirs to replace that expended in propulsion.

The system is made still more effective by taking this air, not from the exhaust-pipe, but from the air-brake cylinders beneath the cars, and thus operating the continuous brakes on each car as well as the same work is done by the common Westinghouse system.

The experimental engine has drawn trains of three and four loaded cars from Harlem to the Battery, New-York City, a distance of nine miles, in two minutes and a half less than schedule time, — forty minutes, — making all stops, and on three-fourths of a single charge of air. The engine will handle well, alone, with a pressure of twenty-five pounds.

It is impracticable to cover long distances without refilling the reservoirs, and it is not proposed to attempt doing so. The reservoirs are to be filled at every ten-miles run, or every forty or fifty minutes; and filling-stations are to be provided at proper intervals along the line of the road. The reservoirs are so well made, that the engine stands all night, under a pressure of one hundred pounds, without appreciable loss of pressure.

The obvious and unquestionable advantages of this method of transportation are: safety from the dangers of explosion, which, aside from simple pressure, are unavoidable with steam and water; perfect cleanliness, not only on the engine, but along the line and on the train, in consequence of the avoidance of dust and smoke, and sparks from the engine; freedom from gas from the locomotive; less noise than with the steam-engine; freedom from the annoyances from dripping hot water, soiling the clothing, and half scalding the unfortunate pedestrian beneath; permanence of the reservoirs, which cannot be burned out, as can the steam-boiler, and which cannot be injured by the corrosion, due to leakage of water and steam, which is so serious a cause of injury to the steam-boiler. The engineer appreciates the latter points particularly, as well as the comfort of having no fire or fireman to look after and to distract his attention from his duties at the throttle, and ahead of the train. He is even saved the responsibility and taxation of 'looking out for the water' in the boiler, which is no small matter on the steam-locomotive.

Comparing the commercial sides for the two motors, the air-locomotive will undoubtedly be found to cost much less for repairs, to lose vastly less time in the shops, and to demand very much less of the time of the engineer and of the master mechanic, when off the road. Whether the cost of running will be so small as to permit the adoption of the system on our elevated railroads, and other railroads to which it may be as well adapted, cannot, as a matter of course, be certainly known until the experiment shall have been tried under all the best conditions for its operation. This is, in fact, the question to be determined. The experiment on the New-York lines is evidently very encouraging; and it is to be hoped that the very favorable estimates offered by its promoters may be confirmed by long trial, and the successful introduction of the motor. So far as we are aware, the compressed-air locomotive has hitherto been used only where, as in the longer lines of tunnels, there existed peculiar reasons for its introduction. The experiment is a perfectly legitimate one, and the new company are entitled to every favor that can be properly accorded those who attempt in any way the amelioration of the annoyances and the dangers of railway travel. R. H. THURSTON.

DANIELL'S PRINCIPLES OF PHYSICS.

A text-book of the principles of physics. By A. DANIELL. London, *Macmillan*, 1884. 20+653 p. 8°.

MANY of those who have been engaged in teaching physics to undergraduates during the last ten years have felt the want of a text-book more in accord with the present condition of the science than the majority of those accessible to the English-reading student. It is doubtless a fact, and a curious one, that those most generally in use in this country are, or perhaps it is better to say were, originally translations from the French; and this in spite of the generally admitted leadership of English-speaking people in this department of science.

Although, perhaps, the best attainable up to the present time, these English translations of French text-books have certainly fallen short of perfect adaptability to the work, and more and more so as the years passed by. It is true that an attempt has been made by the editors and publishers to keep pace with the rapid growth of the science, but this attempt has met with but doubtful success.

Any system or design or scheme which may have existed in some of these books in the beginning has been pretty effectually destroyed by the numerous additions which have been made from time to time, in the placing of many of which the convenience of the printer seems to have been oftener consulted than any thing else.

Although one may find a brief account of the very latest discovery or invention up to the time of going to press, he is likely to find it in a most unexpected place; and, although here and there will be found detailed fragments of modern theory, they are often so purely fragmentary as to be quite unintelligible to the student. In fact, the book comes to resemble a conglomerate in its structure; and the student, in attempting to 'go through it,' meets with sudden and remarkable changes in hardness and density. The fact is, the change which has been going on in the science of physics during the last fifteen or twenty years does not consist alone in the series of brilliant discoveries and inventions which have brought it glory and renown: along with these there

have been almost equally important revolutions in its methods and principles. It is less a collection of facts and experiments than it once was. Indeed, the accumulation of these within the past decade has been so rapid, and the collection is now so vast, as to preclude the idea of even an attempt to enumerate them in a text-book. Fortunately the accumulation of facts has been accompanied by classification and orderly arrangement. Theory and practice have been close companions, each occasionally taking the lead. Not many years ago it was possible, in a text-book of moderate dimensions, to state nearly all of the principal facts relating to certain departments of physics, which are to-day represented by special treatises, numbered by the hundred. The text-book for the undergraduate can no longer attempt to deal with these matters in detail. It must confine itself to a consideration of the established *principles* of the science, with such, and only such, experimental illustrations as are necessary to enable the student to comprehend these principles. Experiments must be typical rather than special in form, and of such a character that the phenomenon to be exhibited is the prominent feature, rather than the particular piece of apparatus with which it is shown.

In the preparation of this book, its author has taken a new departure, and largely in the direction indicated. In glancing through its pages, one is equally surprised, both by the presence of many things which he has not before seen in text-books of a similar grade, and by the absence of many other things to the sight of which he has long been accustomed. Of the latter, the most noticeable, at first, are the fine pictures, the absence of which is a conspicuous feature of the book: indeed, the character of the work is revealed more promptly through this feature than any other. Cuts and drawings are introduced whenever, in the opinion of the author, they are necessary to elucidate the text; but they are generally of the simplest character, and such as can readily be reproduced upon the blackboard, or added to, if thought desirable, by one possessing little skill. In describing an experiment, only the absolute essentials are shown; the details of construction, and special forms of apparatus, being left to the imagination of the student, or the descriptive powers of the teacher. Perhaps the economy exercised in this direction has been a little too rigorous; but the plan possesses great advantages, both direct and indirect. One is spared the elaborate descriptions of apparatus which occupy so many pages of other text-books. It must be admitted that this is, on the whole, a considerable gain. It is often difficult to understand a complicated instrument from a description and a cut; and often the more accurate the latter, the greater the difficulty, as much attention will be given to the really non-essential parts. Students have a perverse way of being interested in the architecture of an instrument, and often receive a more lasting impression from its 'elevation' than from its 'ground plan.' It is not an uncommon experience to find that a man will study an instrument from cut and description in the text-book, and fail to recognize the same thing under a somewhat different form, when it is placed on the table before him. It would be interesting to know how many undergraduate students who have studied electricity are able to distinguish the soul of a galvanometer from its body so completely as to be able to recognize it in all of the numerous forms in which it materializes.

Again: in many instances the instrument so carefully figured and described in the text-book has become obsolete, which can hardly be said of the principle involved.

The omission of this illustrative and descriptive part of the text-book is to be commended because it leaves room, — it leaves room for the introduction of much matter, which is certainly more than the equivalent of that which is omitted.

Considerable gain in space accrues from another noticeable feature of the book, in which it differs materially from those more generally in use.

It is not a book of reference. The reader will not fail to observe the entire absence of tables, and will look in vain for collections of physical constants, or of numerical data, or of the various and varying results of different experiments in quantitative investigations. The history and personal aspect of scientific discovery will be missed by many, and this omission was evidently reluctantly decided upon by the author.

Strip some of our well-known text-books of all these, and they will shrink very considerably in their dimensions. There may be difference of opinion concerning the desirableness of these omissions. Our author has unquestionably assumed, that, wherever his book is used, there will be a good collection of physical apparatus, which may be accessible to the student for examination when desirable; and an enthusiastic and competent instructor, who knows the history of his subject, and can arouse the interest and enthusiasm of his class by suitable references to eventful periods of discovery

and to the personal characters of discoverers. His text-book provides the pupil with the meat of the subject: the side-dishes, dessert, etc., must be furnished by the teacher.

The book is an octavo volume of about six hundred pages, — not larger than several well-known treatises in general use. Only an elementary mathematical training is assumed; so elementary, in fact, that the author has thought it desirable to define the well-known constant π, which he does in a note. Let no one be deceived by this, however: the student will discover, as he progresses, that he must know his elementary mathematics well, and that he must possess facility and readiness in the use of symbols.

In the introduction, some of the fundamental principles on which the science is based are discussed. One or two terms concerning which there has been more or less dispute are handled a little delicately in the beginning. An instance of this is the use of the word 'force.' The author is a little shy about defining it at first. His confidence grows, however, as the work progresses; and he once or twice hints at, but never quite reaches, the neat statement of Clerk Maxwell, that force is 'one of the aspects of a stress.'

A chapter is devoted to the processes of measuring space, time, and mass, in which the rather discouraging statement is made, that "good linear measurement, in whatever way effected, ought to present an error less than one-millionth of the whole." There is a well-written chapter on work and energy, including a brief discussion of the indicator diagram. This is followed by the subject of kinematics, covering more than a hundred pages.

The treatment of this subject is somewhat novel for a book of this class, including, as it does, a tolerably complete discussion of simple harmonic motions, their composition and resolution; a statement of Fourier's theorem; a discussion of waves and wave-motions; the propagation of waves, their reflection, refraction, interference, and diffraction; the vibrations of chords, membranes, etc. In the statement of Ptolemy's law for reflection, and Fermat's for refraction, often known as the principles of least distance and least time, the author has failed to note the very important exceptions to both, or to give the limitations to which they are subject.

There follows the subject of kinetics, in which some general propositions in reference to forces are derived from those already established in the study of motion. Moment of inertia, radius of gyration, and energy of a rotating body, are more thoroughly treated than is customary in such a treatise.

There is a very satisfactory chapter on attraction and potential. Potential of a point in space, equipotential surfaces, lines and tubes of force, etc., are discussed in a manner so clear and intelligible as to enable the student to be somewhat master of the situation when he comes to the practical application of these conceptions. The chapter on gravitation and the pendulum is satisfactory; but, in the last proposition, the author has made the not uncommon mistake of failing to correctly state the conditions of the reversible pendulum. It is a little curious that it is not oftener observed that a symmetrical bar will oscillate about *any* two points equally distant from the centre of gravity in the same time. Students are likely to be considerably puzzled when they attempt to determine in this way the length of a single pendulum, and discover, that, the shorter the pendulum, the longer the period of vibration.

In many text-books the study of matter and its properties forms the subject of the opening chapter; with some propriety, perhaps, as matter is assumed to be the solid foundation upon which the science of physics rests. In this volume, however, it is not discussed until nearly two hundred pages have been passed over. One of the peculiar features of the treatment of the subject by our author is the admission of the ether as a form of matter; and the reasons for so doing are ably presented. Its properties as matter are explained as far as known or surmised, and the vortex atom is not forgotten. The chapter includes a discussion of the molecular constitution of matter, a brief consideration of surface-tension and superficial viscosity, with their application to capillary phenomena, and a brief study of viscosity of solids, liquids, and gases.

The middle of the book is passed before the study of heat is begun. Heat is considered as including two totally distinct forms of energy; and the treatment of what is known as radiant heat is deferred until a later period. Under the head of heat proper will be found some discussion of the principles of thermodynamics, including a treatment of Carnot's cycle. It occupies forty pages, and might have been improved by a more complete presentation of the subject of conduction. Sound is considered through fifty pages, in which musical intervals and scales, the vibration of strings, and the propagation through solids, liquids, and gases, receive rather more attention than is usual.

Under the general head of 'ether-waves,' the unity of the so-called heat, light, and actinic rays is explained. The theory of exchanges, and Stokes's law, are considered. The treatment of color is extremely satisfactory. The origin and propagation of ether-waves, reflection, refraction, and polarization, together with the postulates of Fresnel, Neumann, and MacCullagh, occupy considerable space. All of this precedes what is generally known as geometrical optics, which is not elaborately discussed. In double refraction the Huyghenian construction is given, and the study of optical instruments is remarkable for its brevity.

Electricity and magnetism are provisionally defined as properties or conditions of matter, the matter referred to being that extraordinary form known as the ether. Just enough in the way of experiment is given to enable the student to understand the development of the principles of the subject, which are established under the assumption that he has mastered the chapter on attraction, potential, etc., already referred to. Some of the notable features of this part of the work are more than ordinarily intelligible discussions of thermo-electricity, Peltier's and Thomson's 'effects,' the presentation of Maxwell's theory, with his electromagnetic theory of light, and brief mention of Rowland's, Kerr's, and Hall's experiments. There is also a comparison of units in the electrostatic and electromagnetic systems, and a discussion of the meaning and value of the constant v. The arrangement of topics in electricity and magnetism may be criticised, in that it would seem desirable to have introduced the subject of magnetism and magnetic potential at an earlier stage, thus making possible an earlier exposition of the origin of the electromagnetic units of measure.

In connection with the matter of units, it is worth while to remark, that throughout the work the author has felt constrained, possibly out of respect for an unwholesome English prejudice, to make frequent use of the foot, inch, pound, ounce, grain, etc. It is, perhaps, hardly fair to expect an English author to adhere strictly to the use of the metric system; but in the present instance the confusion of the units is a blemish all the more noticeable by reason of the otherwise simple and elegant methods of treatment. Clumsiness of statement and solution is frequently the unavoidable result. No evidence of this is needed; but it may not be amiss to quote from so conservative a source as Thomson and Tait (Nat. phil., art. 408), who, although selecting the foot as being 'for British measurement generally the most convenient,' remark, that "the British measurements of area and volume are infinitely inconvenient, and wasteful of brain-energy and of plodding labor. Their contrast with the simple, uniform metrical system of France, Germany, and Italy, is but little creditable to English intelligence."

Not the least remarkable feature of the book is, that its author is a lecturer in a medical school, and it "was primarily designed as a contribution to medical education."

Altogether the book must be regarded as one greatly in advance of those of a similar grade generally in use. It is not intended as a substitute for a laboratory and laboratory practice, for no book can be this; but it is admirably adapted for a preparation to a laboratory course, in that it furnishes the student with such "a store of general principles, that, when he comes to enter a physical laboratory, he may then find around him, in the concrete form, a collection of pieces of apparatus the construction and the action of which he is able, by the application of principles already familiar to him, promptly and intelligently to comprehend."

The belief that such a text-book will be gladly welcomed by many teachers of physics in this country may justify the somewhat extended reference to its character and contents, given above.

PROPAGATION OF TUBERCULOSIS.

The influence of heredity and contagion on the propagation of tuberculosis, and the prevention of injurious effects from consumption of the flesh and milk of tuberculous animals. By A. LYDTIN, Carlsruhe, veterinary adviser to the Baden government; G. FLEMING, LL.D., F.R.C.V.S., principal veterinary surgeon to the British army; and VAN HERTSEN, veterinary surgeon, and chief inspector of the Brussels abattoir. New York, *Jenkins*, [1884]. 175 p. 8°.

THIS volume is a translation, by one of the committee upon its preparation, of a report prepared for discussion at the International veterinary congress, held at Brussels in September, 1883. The question of the etiology of tuberculosis is one of the most important of modern medicine, and occupies the attention of a large part of the profession to-day. Its importance is not confined to the human race, in so far as it attacks mankind; but, be-

ing so wide-spread among domestic animals, it necessarily affects humanity in this direction also.

The report before us is a valuable summary of the condition of scientific knowledge at the present day, upon this question, in its relationship to domestic animals, and, through them, to mankind. It begins with an account of the nomenclature of the disease from the earliest times to the present, discusses the best means of diagnosis, the course and the anatomical appearance of the disease. In regard to the latter point, the conclusion already generally accepted by medical men is reached, that the 'criterium' of the disease must be sought in the irritant which causes it, and that this irritant is found in the bacillus of Koch. In connection with this portion of the report, there is a very good discussion of the predisposing causes of the disease (pp. 35–49), followed by a consideration of the animals (other than cattle) that are known to be subject to attack by it. The conclusion is reached, after all this, that "tuberculosis is, of all maladies affecting the domesticated animals, that which is the most wide-spread, and which, of all others, most deserves the qualification of 'panzooty.'"

The second chapter of the book is devoted to a consideration of the question, "What is the influence of heredity on the propagation of tuberculosis?" (pp. 55–68.) After the consideration and quotation of many cases and authors, a number of conclusions are reached, of which the last seems to contain the essence, — "that tuberculous parents may transmit to their progeny a predisposition to tuberculosis."

The second question, "What is the influence of contagion on the propagation of tuberculosis?" receives very thorough consideration. A large number of authors — from Ruhling in 1774, to Villemin and Koch in our own day — are cited to prove the contagious nature of the disease. A summary of the reasons for the opinion that animal and human tuberculosis are one and the same is given (pp. 85–98); and this portion of the work is concluded by a short *résumé* of Koch's labors on this disease.

The discussion of the third question, "What are the preventive measures which should be had recourse to, in order to arrest the injurious effects which may result from the use of the flesh and milk of tuberculous cattle?" is opened with a review of the ancient laws against the use of diseased meat, together with some account of the various attempts made in more recent times to regulate this traffic.

The two plans for the regulation of the sale of diseased meats are thus summarized: "*a*, All preventive measures may be reduced to the simple advice to cook the flesh well before eating it; and, *b*, Flesh of tuberculous animals should be confiscated, either in every case, or in certain circumstances." The first method of procedure is unsafe; because, in the first place, it would probably not be thoroughly done, and, in the second place, a recommendation alone would not influence in the least those who are in the habit of eating raw or almost raw meat (a common practice in Central and North Germany). The objections to, and the difficulties in the way of, the adoption of the second method, that of regulation, are mentioned, and discussed in an exhaustive manner; the effect of laws of partial or complete confiscation of affected animals is shown; the action of 'warranty' laws upon the morals of the butcher and owner, and the general effect of any attempt at regulation upon the cupidity of owners and of all concerned, are well illustrated.

A number of recommendations to the congress are made for adoption, too long for quotation, but seemingly based upon a firm ground-work of knowledge and experience. The report was brought on for discussion at so late a period in the session that not much was done in this direction. The sense of the meeting, however, seemed to be, that some law should be framed, restricting at least the sale of the meat of animals affected with tuberculosis.

The report, as a whole, contributes nothing, from an experimental point of view, to our knowledge of this disease, but, as before stated, is a very complete *résumé* of the question as it stands to-day in its hygienic and pecuniary relations. It will be of interest and importance to all veterinarians, as a summary of the knowledge thus far obtained, and as an index to the original sources from which this knowledge may be drawn. To scientific men actually engaged in the working-out of the problem of the etiology of tuberculosis, it can be of interest only as presenting the case from the veterinarian's stand-point.

The book is well gotten up, and clearly printed, but few errors having escaped the eye of the proof-reader. For ourselves, we should prefer cyst to *k*yst. The addition of an index would have made the book more serviceable to the general reader, and for purposes of reference.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Mineral statistics of the United States. — Mr. Albert Williams, jun., is arranging for the issue of a second volume on the mining industries and mineral resources of the United States, and is now engaged in the preliminary work necessary to facilitate its preparation. This report will cover statistically the calendar years of 1883 and 1884; preserving, however, the record for former years, already published in his first report. The general form and scope of the work will be similar to that previously followed. Repetition of text matter will be avoided, and the chief aim will be to treat in greater detail such topics as could not well be enlarged upon in the first report without extending it beyond the proper limits.

The second volume, while complete in itself from a statistical point of view, will complement the first in the matter of description of localities, metallurgical processes, etc. A change which will add to the interest of the work will be the introduction of a series of graphic statistical charts, showing at a glance the progress in the several industries. A fair start has already been made, and the work will be pushed energetically with a view to secure the promptness in publication which is so necessary in reports of this class. The value of such statistics to the industries whose progress they record is the quickness with which they are given to the public. There is a somewhat prevalent idea that such work cannot be published within a reasonable time after the expiration of the time to which it refers. This is refuted by Mr. Williams's first report, which was issued early in the fall of 1883; and the results of the work, in a condensed form, were given to the public within a few weeks after the manuscript was given to the printer, which was on the 30th of June, to which date the production statistics were carried.

Glacial striae. — Prof. T. C. Chamberlin is collecting and compiling all observations on glacial striation within the limits of the United States. The results of his work will be embodied in a bulletin to be published by the survey. He would be glad to incorporate any unpublished notes which observers may be kind enough to communicate. As full details as practicable are desired, relating to the character of the striations, locality, kind of rock, inclination of striated surface, altitude, and other topographical relations, etc. Professor Chamberlin would also esteem it a favor to have his attention directed to observations recorded in unusual publications, or in those not readily accessible, or for any other reasons liable to be overlooked.

Topographic notes. — The work of compiling topographic material for the map of the District of Columbia and adjoining territory has been completed; and the party under Mr. S. H. Bodfish's supervision was, during March and April, engaged in field-work for the purpose of obtaining data, with the object of finishing the survey of the area left untouched by the coast and geodetic survey. —— Field-work for the completion of the map of the Denver basin will soon be undertaken. Mr. Anton Karl, who has charge of the topographic work in the Rocky Mountain district, has left the Washington office, and is on his way to Denver to begin this work, which was temporarily suspended last summer. He expects to finish it in about six weeks. All that remains to be done is to carry the triangulation over the area, and to complete the filling-in of the contours. The map will include about a thousand square miles, on a scale of one mile to one inch. —— In the division of the Pacific, work during March was much interfered with by rainy weather. Mr. Hoffmann, after completing his map of the New Idria district, proceeded to Sulphur Bank, where he was making good progress, correcting and adding to his former work there. —— Office-work is progressing satisfactorily. Some of the maps are fast approaching completion, and preparations will soon be made for putting the various parties in the field for the coming season.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Torrey botanical club, New York.

May 13. — Mr. Bicknell read a paper upon Carex Pennsylvanica and Carex varia, referring particularly to the difference of habit of the subterranean parts of the plants. C. Pennsylvanica throws out runners early in the year, which soon root, and become underground stems. These extend in all directions from the parent plant, each fostering a succession of shoots, some of which themselves become centres of a secondary series of runners. I have unearthed these runners, bearing, at intervals of a few inches, four or more generations of living shoots, together with the remains of several older generations. It thus appears that the new shoots do not always become established as separate plants, but that often a series of tufts remain permanently attached by underground connection for many years. The *separate* tufts do not appear to live more than about two years. Where this sedge grows in abundance its runners may be found crossing and re-crossing beneath the surface of the ground; and careful excavation will show that many apparently distinct plantlets belong to the same system of underground stem. The runners are at first clothed with closely imbricated scales, arising from nodes all along the stem. These ultimately decay, and become frayed into a coarse fringe, which remains apressed to the stem in whorls from every node. In C. varia the habit of growth is entirely different. This species shows no

disposition to spread laterally, but grows in close tufts. These spring from a dense, knotty mass of small, closely aggregated root-stocks, which bear a profusion of long, fibrous roots. Year after year these rooty masses produce an abundance of new shoots, which rise from the surface amid the old. Each ultimate root-stock becomes the site for a closely clustered colony of compound shoots; and these secondary tufts, compacted into a single mass, make up the plant. A slight lateral prolongation of a shoot is sometimes necessitated by an obstruction in the most direct way to the surface, but this is the nearest approach to subterranean spreading. In no other of our species of Carex, of the section Montanae, do we find the counterpart of the underground stems of C. Pennsylvanica. The closest approach towards them is shown by C. umbellata. From its dense underground tufts, this plant sometimes produces short underground stems; these are, however, more like suckers, and do not stray far from the parent plant, merely assisting to increase its dimensions. C. pubescens is of less tufted habit than either of the other species of this section; the shoots being irregularly produced by a progressive underground stem, or root-stock, which, however, bears no resemblance to the underground runners of C. Pennsylvanica.

The Brookville society of natural history, Indiana.

May 6. — A. W. Butler described the extent of the Niagara formation in Franklin county, and gave a section showing the stratification near the town of Laurel. He described the varying thickness of the strata, the economic uses of the stone, the southwestward dip of the strata, and the quantities of chert which are found in locations on top of the best building-stone. —— D. R. Moore gave an account of some peculiar mounds in Butler county, O., and Franklin county, Ind., confining his time mostly to the 'Glidewell mound,' four miles northeast of Brookville. This mound is situated nearly three hundred feet above the east fork of the White Water River, on the point of a ridge jutting out into the river. The mound is sixty feet in diameter, and at present is twelve feet high. It is built of earth which has been brought from some other locality, as no such earth has been found within about half a mile of its location. The mound has been covered with large, flat stones, overlapping each other after the manner of shingles on the roof of a house; and these stones are now covered with vegetable mould, in some places to a depth of almost two feet.

Academy of natural sciences, Philadelphia.

April 29. — Mr. Joseph Willcox called attention to a fine collection of upwards of eighty specimens of fifty species of marine sponges made by him during the winter in Florida, and presented to the academy. Continuing his remarks on the geology and natural history of Florida, Mr. Willcox stated that the rocks which line the west coast extend out for many miles into the Gulf of Mexico, making the waters very shoal. The channels of the streams from the mainland continue out through these rocky shoals in the same direction, and with the same tortuous course as before reaching the shore. The limestone of the peninsula is soft, and eroded into a vast number of caverns and sink-holes. Where exposed at an elevation, the rock becomes hard and firm, in some localities resembling marble. Referring to Agassiz's suggestion that the sea-urchins of the coast which cover themselves with seaweed do so for protection, the speaker remarked that such an explanation was open to doubt, as allied forms which have the habit of covering themselves with little mounds of white shells are rendered thereby much more conspicuous. The common conch of the coast, Busycon pyrum had been found spawning under the sand, the egg-cases always being attached to a shell at least eight inches below the surface. He had been interested in the numerous saw-fishes which swim about in shallow water. When approached, they settle quietly in the sand until partially covered, when, feeling secure, they will allow themselves to be almost touched before darting away. In this condition, they are readily held down with a spear, when they elevate the head, turn up the saw, and pull it repeatedly, and with sufficient force to make a deep notch in the wooden handle. —— Referring to the collection of sponges, Mr. Edward Potts remarked that they were all siliceous, with the exception of one interesting calcareous species. He had received several fine fresh-water sponges from the St. John's River, in the neighborhood of Palatka, collected by Mr. Mills of Buffalo. He believed one of the forms to be an undescribed species of the genus Meyenia, for which he proposed the name subdivisa. He was informed by Mr. Willcox that the comparative scarcity of fresh-water sponges in that region was, doubtless, owing to the superabundance of confervoid growths, which not only covered submerged logs, etc., but also flourished on the backs of the alligators.

NOTES AND NEWS.

THE *American* of Philadelphia announces the *personnel* of the new biological department of the University of Pennsylvania as follows: "At the head, as director, and professor of anatomy and zoölogy, was placed, of course, Dr. Joseph Leidy, whose selection guarantees to the scientific world the value of the new department. With him are to be associated Dr. J. T. Rothrock, professor of botany; Dr. A. J. Parker, professor of comparative anatomy; Dr. Harrison Allen, professor of physiology; Dr. Horace Jayne, professor of vertebrate morphology; and Dr. Benjamin Sharpe, professor of invertebrate morphology. That there will be enthusiastic, earnest, and thorough work done, is insured by all of these names."

— *Nature* states that tickets have been applied for as follows for the Montreal meeting of the British association: members elected prior to October, 1882, 379; members elected since October, 1882, 181; associates (relations of members), 120: total, 680.

— Mr. W. T. Lynn, late of the Royal observatory, Greenwich, writing to the *Observatory*, on the eclipses

during the war of Xerxes with the Greeks, makes an attempt to decide upon the most probable nature and dates of these 'eclipses,' which have occasioned chronologists so much trouble, from the assumption that they were solar eclipses, and from the difficulty of finding any such eclipses that could be identified with them. In the history of Herodotus, two 'portents' are said to have happened in the sky (besides many terrestrial ones) during the memorable war between the Greeks and the Persians under Xerxes, and (after his flight from Salamis) under Mardonius. The first of the two is mentioned in the seventh book of Herodotus, where he says, that in the early spring, while Xerxes was at Sardis preparing to set out on the Grecian expedition, "the sun, leaving his seat in heaven, became invisible, and, instead of day, it became night." The date when this expedition, and the battles of Thermopylae and Salamis, took place, is considered to have been B.C. 480. No eclipse of the sun could, however, have been visible in western Asia during the spring of that year. Sir George Airy suggested, in 1853, that the total *lunar* eclipse of B.C. 479, March 14, was the probable cause of the alarm and inquiry of Xerxes. Mr. Lynn, reviewing briefly the evidence on this point, concludes that this 'portent at Sardis' (respecting which Herodotus could not have been in possession of full information) was really of the nature of some remarkable meteorological phenomenon. But of the other 'portent' referred to by Herodotus in his ninth book, Mr. Lynn regards his account as likely to be more accurate, as it was visible in Greece. The prodigy was this: "While he was offering sacrifice to know if he should march out against the Persians, the sun was suddenly darkened in mid-sky." Mr. Lynn finds that a large solar eclipse (but not nearly total) occurred on the 2d of October, B.C. 480; and he is inclined to the belief that this was the phenomenon which frightened Cleombrotus, the brother of Leonidas, who was in command of the Spartan troops.

—In a recent scientific *feuilleton* in the Paris *Débats*, Mr. Henri Parville quotes a reference to the singular action of oil on waves by Theophylactes, the Byzantine historian of the sixth century. The passage occurs in a dialogue on 'various natural questions.' The question propounded is, why does oil make the sea calm? and the answer given is to the effect, that as the wind is 'a subtle and delicate thing,' and oil is 'adhesive, unctuous, and smooth,' the wind glides over the surface of the water on which oil has been spread, and cannot raise waves, not being able to obtain any hold on the water.

— The Linnean society of New South Wales offers a prize of a hundred pounds for an essay on 'The life-history of the bacillus of typhoid-fever.' The essay should be received by the society not later than Dec. 31, 1884. The intention and wishes of the donor of the prize will be best given in his own words: — "The questions chiefly to be solved in the investigation of the life-history of the bacillus of typhoid-fever are: 1°. What are the specific characters of the organism, as distinguished from other bacteria? 2°. What are the changes, if any, which the organism undergoes in the human body? 3°. What are its modes of development and reproduction in the human body? 4°. What changes or metamorphoses, if any, does the organism undergo after ejection from the human body, or in any other condition of its existence? 5°. What fluids or other substances seem best adapted for the growth and multiplication of the organism? 6°. Can the organism live or be cultivated in pure or distilled water? 7°. What are its limits of endurance of heat, cold, dryness, or humidity? As far as these points are concerned, the author should confine himself entirely to facts which come under his own observation; and those should be given in detail, with a full explanation of the method of investigation. But in dealing with the results obtained by these investigations, and the consideration of the means whereby a knowledge of the life-history of this most dangerous organism may help towards its eradication, the theories and observations of others may appropriately be referred to; but in every such case the authority must be correctly cited. The chief points to be ascertained in this branch of the subject are: 1°. How, and under what conditions, does the organism get access to the human body? 2°. How can its growth be impeded, or its vitality destroyed, in the human body, without serious injury to the individual affected? 3°. How can it be eradicated or rendered innocuous in wells, water-holes, drains, etc.?"

The president of the society, in announcing the prize, remarked that the present seemed to be a very opportune time to bring this matter forward, as the subject was now engaging the serious attention of medical men, owing to the prevalence of typhoid-fever. He had been given to understand that Australia offered exceptional opportunities for the investigation of the bacteria, as the climate was favorable for their growth during the greater part of the year.

— Professor Tyndall has given during the past winter, at the Royal institution, a course of lectures on 'The older electricity, its phenomena and investigators,' showing what was known of electricity up to the time of Faraday; at first thought, not a promising subject, but apparently successfully worked out by the lecturer.

— Prof. C. A. Young's 'The sun' (one of the International science series) has been translated into Russian, as well as into French, German, and Italian. In England eight thousand copies have been sold, and it has been very favorably received in this country.

—A very ingenious arrangement has been made by the Great northern telegraph company of England for telegraphing to China. The peculiarity of the Chinese language is, that the single characters do not stand for letters, but words, of which there are six thousand. For use on the new Chinese lines, the company has had special wood blocks made, on one end of which the word and facsimile are cut, while on the other end a number specially standing for the word is cut. The telegrapher substitutes the numbers for the words in transmitting a telegram, while

messages arriving in the numbers are deciphered in the same manner by means of the blocks.

— An attempt will be made to place the collections of the late Dr. Engelmann, of which he made no disposal, in the Shaw botanic gardens of St. Louis.

— In a recent article on the Edinburgh university festival, *Nature* says, "Silently and unconsciously, perhaps, the universities are passing from the exclusive domination of the older learning. At Edinburgh the emancipation is far advanced, but has yet to take shape in a definite re-arrangement of the curriculum of study. No thoughtful scientific man would advocate a merely scientific education. The foundations of every man's culture should be laid broad and deep in those humanizing departments of thought which the experience of centuries has proved to be admirably fitted for the mental and moral discipline of youth. But the day is not far distant when it will be acknowledged that modern science must be admitted to a place with ancient philosophy and literature in the scheme of a liberal education, when in all our universities provision will be made for practical instruction in scientific methods, and when at least as much encouragement will be given by fellowships and scholarships to the prosecution of original scientific research as has hitherto been awarded to classical study or learned indolence."

— Dr. V. B. Wittrock, curator of the herbarium of the Royal academy of sciences, Stockholm, Sweden, has issued, in a handsome folio volume, the first fasciculus of his Erythraea exsiccata, in which he proposes to represent and illustrate all the known species and forms of this critical genus. He wishes to include the American forms, and, likewise, the few European ones which are naturalized in North America. In this view, he invites the correspondence and co-operation of those American botanists to whom species of Erythraea are accessible. No truly indigenous species occurs on our Atlantic border: so this announcement is particularly addressed to botanists in Arkansas, Texas, and especially New Mexico and California.

— Antimony ores have been found in numerous parts of New South Wales. The ore consists of oxide and sulphide of antimony, and occurs in original bunches, occasionally of a considerable size, enclosed in a quartz matrix, which forms the chief constituent of the lodes.

— Whoever wishes to consult a concise compilation on primitive metallurgy will find Dr. Andree's *Die metalle bei den naturvölkern* (Leipzig, 1884, 166 p.) a most useful work. The subject is divided according to the geographical distribution of the peoples using the metals. The first two chapters, about one third of the book, are given to the discussion of iron and copper among the Africans; another third is taken up with the consideration of Asiatic metallurgy; and this is followed by five chapters on the iron, copper, bronze, and gold of America, with a final chapter on the use of iron in the South-Sea Islands. There are fifty-seven figures of various native blast-furnaces, bellows and tongs, of Africa, Asia, and Malaysia, and of the metal implements and ornaments of America. These all are referred to their original sources. A great number of authorities have been consulted, and all are noted conscientiously. The work deserves a place in the working-library of every student of the primitive arts; while its method and style are such as to interest the general reader.

— In a lecture on the dawn of mind, delivered at Owens college, Manchester, Eng., March 28, by Mr. G. J. Romanes, he claimed that the whole structure of mind took its rise from excitability, or the aptitude to respond to nervous stimulus, which was a characteristic of all matter that was alive. Next to excitability, in an ascending scale, they had the functions of discrimination and conductibility. Discrimination he believed to be a function of all nerve-cells: it was the power to discriminate one stimulus from another, irrespective of the degrees of their mechanical intensity. Conductibility was a function which admitted the possibility of reflex action, and of the co-ordination both of muscles and of ideas. In the faculty of discrimination they had the physical aspect of that which elsewhere was called choice; because choice, if it was analyzed, was merely the power of discriminating between one stimulus and another. With the aid of an elaborate diagram, Mr. Romanes traced what he held to be the various grades in the process of mental evolution from excitability as the root of the mind. The diagram had forty lines or levels. Any given level represented the earliest stage in the development of all the faculties named therein; the animals in which, and the age of the human being at which, they first appeared; also the grade of development at which human intelligence was arrested in idiocy and deaf-mutism. The diagram was not, he said, a mere production of his imagination, but was the result of his study of the subject. At the bottom, on a level with excitability, he placed protoplasm. Reason, he thought, arose out of the powers of perception; for the simplest possible perception involved some act of inference,— an act unconsciously performed, perhaps, but performed all the same. Regarding reason in its lowest phase, it must be placed immediately above the association of ideas, because they might regard it as a process of unconscious or deliberate inference, and this occurred in monkeys, dogs, and elephants. Next above reason he placed indefinite morality, or the germ of conscience. Indefinite morality was the feeling of dislike at offending those for whom the child or animal having it felt an affection. Definite morality was much higher in the scale: it was, in fact, at the top, on a level with man. A child at birth he placed, in this process of mental evolution, on a level with jelly-fish; at five months old, he put the child on a level with pigs, horses, and cats; and at nine months, on a level with the anthropoid apes. He could not help feeling that the doctrine of evolution, as a whole, was a somewhat hard doctrine, — hard as an answer to the question which must at some time, or in some shape, have occurred to most: 'Shall not the Judge of the whole earth do right?' The answer that evolutionists made to that seemed to him to be a hard one; for it said, that in the order of nature the

race was always to the swift, and the battle, without fail, to the strong. Thus the voice of science proclaimed a new beatitude: 'Blessed are the fit, for they shall inherit the earth.' This doctrine seemed to constitute might the only right. But if this world was a world of sorrow, struggle, pain, and death, at all events, the result, so far, had not been altogether profitless. Whatever the 'far off divine event' might be, to which 'the whole creation moves,' the whole creation, with all its pain, and in all its travail, was certainly moving, and moving in a direction which made, if not for righteousness, certainly for improvement.

— The Italian government has determined to offer, on the occasion of the opening of the Turin exhibition, a prize of four hundred pounds for the most practicable process for the transmission of electricity.

— At a recent meeting of the New-York academy of sciences, Mr. G. F. Kunz stated, that while unpacking some specimens of fluorite from Amelia county, Va., he had noticed the display of phosphorescence, a pale greenish light, by the mutual attrition of the specimens, the same being excited also by the warmth of the hands. By the heat of a candle, this phosphorescence was increased, and, on a red-hot stove, became a deep emerald-green. This led Mr. Kunz to examine fluorite from over a dozen localities, and he found that only chlorophane yielded phosphorescent light by attrition. In Phillips's Mineralogy, edition of 1823, a specimen of fluorite, described by Pallas, from Siberia, is mentioned, which yielded light by the warmth of the hand. The fact that attrition will cause phosphorescence, Mr. Kunz considered new; and as the same result was produced by chlorophane from Branchville, Conn., it was looked upon as a new distinguishing characteristic between chlorophane and common fluorite, as pectolite from Bergen Hill is distinguished from the fibrous zeolites and other associated minerals.

— Dr. Otto Struve states, in a letter to Dr. David Gill, that, during the publication of vol. x. of the Pulkova observations, he has reduced a series of parallax measurements of α Tauri (Aldebaran) made thirty years ago. Twenty observations give for the parallax (from position-angles), $0''.500 \pm 0''.075$; while the distance-measures give $0''.538 \pm 0''.089$, the mean being $0''.516 \pm 0''.057$. The agreement of the values obtained by these totally different methods is to be regarded as evidence of a comparatively large parallax, and shows that there are still large parallaxes to be looked for among the stars.

— Mr. Khersevanoff, director of the Institut des ingénieurs des ponts et chaussées of St. Petersburg, has elaborated a project for a grand work on the physical geography of Russia. Woeikof, the well-known meteorologist, has just issued a volume on the climates of different parts of the earth. Barabosh has devoted some years to the study of Manchuria. The results of these studies, made on the spot, have at last been printed by the authorities, but the work is not on sale. The annexation of Merv has again called the attention of geographers to the great work of Grodekoff on the Turkoman country, of which the third volume has recently appeared, and the fourth is printing. A work by Alikhanoff, printed by the general staff, as well as the detailed report of Lessar, recently summarized in these columns, have been issued, but are also withheld from publication. Lessar has received the gold medal of the Imperial geographical society, and is again at work in the field, where he is charged with the reconstruction and improvement of the wells along the route from Askabad to Merv.

— The great chart of Russia in Asia, comprising not only the Russian possessions, but portions of China, India, Persia, the whole of Beluchistan and Afghanistan, and nearly the whole of Russia in Europe, has been appearing in sheets during the last six months, and is now completed. In spite of the faults inherent in such a vast undertaking, it will prove most useful; and the eight large sheets, on a scale of 1 : 4,200,000, are sold at the low price of ten francs.

— There has recently been formed at St. Louis the St. Louis society of microscopists. This organization is distinct from the St. Louis microscopical society. The officers are: president, Frank L. James, Ph.D., M.D.; vice-president, W. B. Hill, M.D.; secretary, H. Ohman-Dumesnil, M.D.; treasurer, Thomas F. Rumbold, M.D.

— A prison congress is to be held in Rome in October, 1884. The circular calling attention to the congress is issued by the U.S. bureau of education, with an apology for touching upon such matters as having to do with the discipline of this life.

— In the discussion at a meeting of the London Society of arts, on Dr. Percy Frankland's paper on Thames water-supply, Sir Robert Rawlinson gave some facts, from his long experience as a government sanitary engineer, that are of special interest with reference to the theories brought into prominence by the cholera commissions. He denied that the much-praised mountain streams were any purer in regard to organic matter than ordinary river-water, since "every particle of growing matter was imbued with ammonia, which would combine with the water, and there was also the chance of other forms of impurity from decaying organic matter," and they often had a bad effect on the health of strangers, who were well enough where the water was supposed to be much worse. "It seemed to be a question of acclimatization," and he believed that the changing from one class of water to another might be very injurious. "But, taking water as it is found on the surface of the earth, he would say, that, out of the whole population of the globe, ninety-five per cent must be drinking water, which, according to chemical tests, ought most seriously to injure the health; and more than fifty per cent of the water would horrify any person who had its chemical contents explained to him." In India and China, water was always polluted; and on the European continent wells were almost invariably sunk in farmyards. In 1833, 1849, and 1854, cholera prevailed in the district of Stafford-

shire, which drained into the river Thame, from which Birmingham draws its water-supply; yet Birmingham escaped. When there were two thousand cases of cholera in Newcastle-upon-Tyne, and the water at Tynemouth was so bad that it was sold in cans with flannel tied over the nozzles to keep the impurities back, not a single case of cholera occurred in Tynemouth. In the Crimea the Sardinian contingent of the army was stationed on a hill, and their water-supply was drawn from a large Prussian fountain in the oolitic rock; yet, of the sixteen thousand men, a thousand died from cholera in the first month. When he came back to England, he heard Dr. Snow explaining the theory that cholera-polluted water was necessary to the production of cholera; and he then said to him, that he must be mistaken, because he had seen, on the largest possible scale, that it was not a fact, and, whatever might produce cholera, he was satisfied that it could not be imputed in all cases solely to impure water.

— Appendix No. 7 of the coast-survey report for 1883 is a 'Table of depths for harbors on the coasts of the United States,' prepared in outline by Commander Lull, and expanded by Messrs. Bradford and Parsons. The harbors are arranged in order along the coast from Maine to Texas, and from California to Alaska; and for every one the depth of water is given for the various bars, channels, and anchorages at high and low water of mean and of spring tides. This occupies one hundred pages, and is followed by an index of twenty-four more, making a work of great thoroughness, that must prove of high value to all of our coasting-vessels. A brief introductory mention of the tides states, that along our eastern coast to St. Augustine, Fla., the tides show no diurnal inequality, the two tidal waves of a single day being practically equal in range. On the Pacific coast the tides are of the more normal type, showing a diurnal inequality in height of flood, that becomes most apparent when the moon is farthest north or south of the equator, and disappears when it is on the equator. This is also characteristic of the peninsula of Florida; but along the northern coast of the Gulf of Mexico, to the Rio Grande, there is but one tide in each lunar day, and that is of small range, and disappears when the moon is on the equator. 'Wind tides' are here very marked, especially with on or off shore winds that blow for several days. The range of tide can be closely determined from the harbor tables.

— The report of Admiral Mouchez, director of the Paris observatory, was presented to the council at a recent meeting. The number of meridian observations made in 1883 amounted to the number of 23,830, five times the largest number made at any other establishment. A new fifteen-inch telescope was completed during the year, and with it one of the satellites of Mars was observed during the opposition of January. After the reading of the report, there was a special discussion respecting the removal of the principal instruments of the observatory to a position outside the city of Paris. This project has met with much opposition in the academy and elsewhere; but the observatory feels obliged to urge it, from the impossibility of finding a good foundation for large instruments. A piece of ground was purchased from the city a few years ago, on which to mount the great telescope of twenty-nine inches aperture, which is now in course of construction. The whole region is, however, so mined by the catacombs, that no good foundation can be secured; and it is considered absolutely necessary to mount it outside the city. It is considered that the grounds now owned by the observatory could be sold for a sum sufficient to found a new establishment.

— Mr. Arthur F. Gray has earned the thanks of conchologists by preparing, in a neat octavo of twelve pages, a complete list of the scientific papers of Thomas Bland. The works of this veteran and philosophical student of the Mollusca extend over the period of thirty years subsequent to 1852, and are seventy-two in number. Several were published jointly with Mr. W. G. Binney, and the series is one of which any naturalist might well be proud. We trust Mr. Bland may be spared to enlarge it indefinitely.

— The immense work of Mr. Elisée Reclus, the *Nouvelle géographie universelle*, begun in 1874, has now reached its ninth volume. The subscribers have received their promised instalments regularly, and without fail. The last volume deals with southwestern Asia. The *Athenaeum* says, "That one man should have been able to do so large an amount of work, is matter for surprise; and that he should have done it so well, is almost phenomenal.

— Lieut. E. K. Moore, in a paper reprinted from No. 29 of the Proceedings of the U. S. naval institute, has given a detailed description of the method of testing chronometers at the Naval observatory. A small 'temperature-room' was built with double walls, the space between the walls being filled with sawdust. This room is heated by the circulation of hot water, and is cooled by ice in a refrigerator beneath the flooring, when a temperature below that of the outside atmosphere is required. The heating-apparatus, which is in a room adjoining the temperature-room, consists of a small copper boiler, under which are two Bunsen burners. The boiler is fed from a tank overhead. In the gas-pipe supplying the burners, there is a spring valve, operated by the armature of an electro-magnet. Two minute gas-jets serve to light the larger burners when this valve is opened. The electro-magnet is in circuit with a mercurial thermostat, which is so adjusted, that, when the mercury in the tube of the thermostat is at or above a height corresponding to the temperature at which it is desired to keep the room, the circuit is closed, and the gas is cut off from the burners; but, if the mercury falls below this point, electric contact is broken, the valve is opened, and the water heated and caused to circulate in the pipes which pass around the room and return to the boiler. This automatic arrangement has been found to keep the temperature within a range of two degrees.

Some time during the cooler months of their trial, the chronometers which are to be tested are placed

in the temperature-room for about fifty days, and during this time they are given two tests at three different temperatures (between 45° and 90°); one set going from a lower to a higher temperature, and one from a higher to a lower, always beginning with one extreme, and ending with the same. The chronometers are also tested for polarity by rating them with the XII of their faces north, south, east, and west successively. "Great care should be taken, when chronometers are suspended in their gimbals, that they swing perfectly free, but without play enough to give them a jar; and the gimbals should be so adjusted that the chronometers will always hang with their faces level." Two chronometers, both running very regularly, were canted 9°, first with the XII down, then with the VI, IX, and III down successively, leaving them two 'terms' of seven days in each position, and placing them level again for two terms between the successive changes. "They both *lost* on their level rates, varying from five-tenths to three seconds, and were more or less irregular; but, when placed level again, they each time came back to their regular rates, running a little irregularly at first." The paper is illustrated by a number of drawings of the apparatus, diagrams of temperature curves, etc.

— The following item comes from the Pilot-chart data, collected by the hydrographic office, under date of Philadelphia, May 15: "Schooner M. A. Nutter (British), at this port, from Bahia, reports on April 21, at 9 A.M., latitude 21° 6′ north, longitude 61° 44′ west, the vessel was shaken from stem to stern by the shock of an earthquake, apparently from the westward." The position assigned for the vessel places it in deep water (about three thousand fathoms), about two hundred miles north-east of Sombrero, Windward Islands; and the date of the shock is noteworthy as being a day before the recent disturbance in England.

— Herr Moritz Honigmann's fireless locomotive, worked by chemically induced heat, has been used regularly since March 31 for passenger-traffic between Stolberg, near Aix-la-Chapelle, and Würfelen. When charged, it is found, the locomotive will go for twelve hours.

— Capt. Sörensen has communicated some important observations, taken in the arctic seas, to the Société de géographie of Paris. They include numerous rectifications of the charts of Spitzbergen, especially of the shores of the canal between the West Island and Prince Charles Island, and of Wood Bay, the head of which is divided into two arms, like Wijde Bay. From Cape Platen, North-east Land, Capt. Sörensen saw on the 28th of August, to the north and east, a land composed of an elevated plateau, cut into two parts by a fiord. A shipmaster from Tromsö also saw this land in 1876, and it is indicated on a chart of these seas issued at Tromsö by the captains of that port. This is probably the Gillis Land of old charts, lying between Spitzbergen and Franz Joseph Land.

— One afternoon, during the recent cruise of the Albatross, in the Caribbean Sea, several boobies were flying around the ship; and finally one of them alighted on the forecastle, when he was caught by one of the men, who, after amusing himself and his ship mates a while, tossed it overboard, expecting it would take itself off as quickly as possible; but, to their surprise, it returned immediately, alighting on the rail, where nearly every man of the crew had congregated to watch its performance. It did not seem to be distressed in any way, and went deliberately to work re-arranging its plumage, which had been somewhat ruffled by handling, calmly surveying the noisy crowd of men gathered around it. They tried to feed it, offering every thing that could be found, but nothing seemed to suit its taste. It would not submit quietly to being handled, but made no attempt to fly away; and, although tossed overboard six times during the afternoon, it returned as often, invariably alighting in the same place among the men, where it finally took up its quarters for the night, remaining till six o'clock the next morning, when it left without ceremony, and was not seen afterward.

— The working in agate, jade, and chalcedony, done at Idar and Oberstein in Germany, was described by Mr. G. F. Kunz at a recent meeting of the New-York academy of sciences, and many of the articles manufactured there exhibited. Some perforated carnelian ornaments were shown, in which the perforations, round at one end and over an inch across, run to an acute point, and vary in length from two and a half to four inches. These ornaments are sent to the interior of Africa, and sold at from four to five cents each, and are there worn by the natives. A jade pendant was shown over an inch and a half long, being one of a lot of over two hundred pounds of jade made up and sent to New Zealand. Mention was made of a mass weighing nearly three hundred pounds, to be used for the same purpose. The cost of making these ornaments at Oberstein was about forty cents each, which was much less than they could have been made for by native or skilled New-Zealand labor. There was also exhibited an oval carnelian disk that had been shaped for cutting by chipping with a small hammer: this chipping is equal to any that can be seen on American stone antiquities, and the entire cost is perhaps one cent. Some onyx beads were also shown, that in London or Ceylon would bring from ten pounds to twenty pounds sterling per string, and were here made for as many dollars. Mention was made of an American who achieved a fortune by importing the elephantine dentalium from the Red Sea, and selling to our American Indians. These instances illustrated the far-reaching influences of modern commerce in the most remote regions of the earth, and also the increasing difficulty in determining the genuine character of supposed aboriginal work in jade, chalcedony, and other similar material.

— Charles Adolphe Wurtz, the distinguished French chemist, died May 12, in his sixty-seventh year.

— The Houghton farm has issued in pamphlet form (ser. iii., No. 3) an account of experiments on the diseases of plants as affected by different fertilizers and the condition of the soil.

SCIENCE.

FRIDAY, MAY 30, 1884.

COMMENT AND CRITICISM.

THE despatches from Washington recently contained the following paragraph: "Owing to the failure of congress to appropriate the money asked for to publish the monthly pilot-chart issued from the hydrographic office, and to cover the expenses of the branch offices at the various ports of the Atlantic and Pacific coasts, orders were issued from the navy department to-day to close those offices on the 1st of July next, and to discontinue the publication of the pilot-chart after that date." A disinterested observer might express regret at the necessity of economy so stringent as this, and surprise at so marked a sign of national poverty. His surprise would probably be increased, on reading further, in the news of the same day, the statement that it is proposed in congress, with much probability of success, to remove a former limitation of the pensions act, so as to make valid about fifty thousand claims filed for arrears of pensions, averaging twelve hundred dollars apiece, — a bill for sixty million dollars. An additional amount would be required to provide for similar claims, that would be filed in case this wholesale bill became a law; so that it would involve in the end the expenditure of over a hundred million dollars.

We may well leave it to the economical politicians and political economists to decide whether so considerable a share of the sum lately reported to be in the treasury vaults should be expended on unexpected pensions. It is sufficient for our purpose simply to call attention to the fact that the possibility of the mere consideration of such a pensions-arrears bill is enough to convince any disinterested observer that true economy can have no share in the crippling of the work lately entered on by the hydrographic office. The failure to vote appropriations for this work is a selfish economy, practised in a quarter where those in power hope it may not seriously affect them. The lavishness of the proposed pensions-arrears bill is a selfish generosity, arising less from regard for the pensioners than from desire for the votes they may control. On the basis of special appropriations, the hydrographic office undertook a task that has been well performed, bringing out valuable results, that have been well received; and now, just as it is fully under way, an unfair and undeserved neglect requires its suspension. There is neither propriety nor justice in such arbitrary action.

It happens that a reduced copy, prepared several weeks ago, of one of the charts in question, appears in this number of *Science*, from which our readers may form some estimate of the care expended in its production, and of the value to nautical men of the great amount of timely information presented upon it. It is difficult to understand how a congress that is professedly desirous of reviving and encouraging our shipping interests can wish to discontinue the issue of a set of charts that contribute directly to the safety and success of our merchant marine; or to dis-establish the branch hydrographic offices in several of our larger ports that furnish the most recent and trustworthy nautical information to masters of vessels about embarking, and that gather in and preserve for the best future use the observations of those who have just come ashore from voyages across the seas.

UNQUESTIONABLY, many of our agricultural publications deserve the severe censure which has been bestowed on them for diffuseness, and for a tendency to use padding to an unwarrantable extent; but these two censurable faults are due to the exigencies of the case. Most of these publications are designed for the entertainment, or rather the improvement, of

bucolic readers, and they doubtless serve their purpose: it is, however, a fair question, whether a scientific man has the right to bury his discoveries, or even the confirmatory results of his researches, by giving them only to publications of this character. The wheat may be served up with chaff as provender, if need be; but a portion of the same wheat, judiciously winnowed for presentation in the journals of our learned societies, or in the established periodicals which are widely accessible to scientific men, would doubtless yield a fairer return to science. It is, in short, exasperating to find important facts regarding the structure and the life of domestic animals and cultivated plants published only in the midst of details which are of little interest to any one, except as they may have a remote influence upon possible appropriations by a legislature. We submit, that it is the duty of experimenters, who are obliged to publish in such ephemeral, not to say trashy pages, to present the scientific features of their useful work also in a more worthy manner.

The account given in our notes, of an engineering work planned in western New York, may serve to convince those cautious legislators who look chiefly for immediate results from the forces which they set in motion, that even so theoretical an affair as a state topographical survey may have direct and practical ends. A large swamp occupies a district that might be valuable agricultural land, and spreads its unhealthy exhalations over the adjoining country. The farmers thereabouts, impatient at the slowness of the outlet-stream in cutting down the rocky barrier that holds up the swamp, ask for state aid to hasten the deepening of the channel. The state surveyor is called to their aid: he examines the ground, and reports that the undertaking is entirely feasible, and that, while thus to discount nature's work will cost somewhat over one hundred thousand dollars, the operation may nevertheless commend itself even to the most careful counter of the cost, for the value of the drained land will be increased over one million dollars.

LETTERS TO THE EDITOR.

The cranial ribs of Micropterus.

In No. 65 of *Science*, Mr. Shufeldt has called attention to a pair of rib-like structures articulating with the 'base of the occiput' in Micropterus salmoides. He is apparently inclined to refer them to an occipital vertebra. Sagemehl has lately (in the *Morphologisches jahrbuch*) advanced a theory to the effect, that, in the occipital region of all teleostean skulls, there are a certain number of vertebrae which are to be compared to the anterior spinal vertebrae of the elasmobranchs, and which have fused more or less completely with the true coalesced occipital vertebrae; i. e., those corresponding to the vagus branches. Without either condemning or supporting this theory, I may point out, that, even though spinal vertebrae should have been taken up into the skull, there is no apparent reason why their ribs should persist. The ribs of teleosts are ossifications of the internal portions of the myocommata, and on the disappearance of these, consequent on the abortion of the segment, one would naturally expect the disappearance of the ribs also.

I have, unfortunately, not been able to examine a black bass osteologically, and therefore cannot speak with any degree of certainty as to the nature of the structures described by Mr. Shufeldt. There is, however, a very possible explanation for them; and that is, that they are portions or rudiments of the supraclaviculae. In many fish these are two T-shaped structures, the portion corresponding to the perpendicular limb of the T being, in each, horizontal, and articulating with the lower portion of the occipital region; while one end of the portion corresponding to the transverse limb articulates with the pterotic and epiotic, and the other end with the mesoclavicula. If the perpendicular limb were to ossify separately, or if the transverse limb should become rudimentary, a condition would result, apparently similar to what Mr. Shufeldt describes.

This is, of course, merely a suggestion, thrown out for the purpose of arriving, if possible, at a correct identification of these peculiar structures.

J. Playfair McMurrich.

Ontario agricultural college, Guelph, Can., May 13.

A singular optical phenomenon.

The phenomenon described by 'F. J. S.' in *Science*, No. 57, and which I at first thought must have been a binocular phantom image, I now think has been truly explained by Mr. Oliver in No. 63. If so, it is only one of a class, examples of which may be seen on every side. I never pass a picket-fence, with another similar fence beyond, without observing and admiring the broad waves of interference running rapidly in one direction or the other. I never look through two fly-screens, one behind the other, without remarking the tortuous shifting waves of interference, like waves of *watered silk*. A lady's silk veil loosely folded shows the same effect beautifully. Of course, the phenomenon is well known and understood; but I was misled by the fact that 'F. J. S.' described it as in mid-air, and nearer the fly-screen. I suppose it may be imagined at any distance, but is usually referred to the plane of one of the objects.

Joseph LeConte.

Berkeley, Cal., April 28.

Popular names of California flowers.

A botanist, coming to the Pacific coast, may be surprised at the large number of plants that are generally

known by their true scientific names. This is the case with Eschscholtzia, Romneya, Clematis, Isomeris, Silena, Malva, Ceanothus, Hosackia, Ribes, Phacelia, Gilia, and many others for which the generic name has become a popular name.

This is owing to various causes, one being the difficulty of applying the old familiar garden names; which are used, however, when any resemblance can be traced, as is the case with larkspur, honeysuckle, columbine, etc. Many of the settlers have also become familiar with the true names of these flowers by having received them from parties that have introduced them to cultivation, for which the greatest credit is due to the late James Vick.

Many visitors, as well as settlers, seek to learn the names of the many strange and beautiful flowers, that, by massing, become such a feature in the scenery, and find the 'dry' scientific names as easy to learn, and as sensible, as the old Spanish names, but few of which survive in the popular mind. Thanks to the little botany of Volney Rattan, largely supplemented by visiting and amateur botanists, all are enabled to learn the more common species with comparative ease. C. R. ORCUTT.

The use of the method of rates in mathematical teaching.

In the case of the question, "Does change in the rate of motion take place at an instant, or during an interval?" I am surprised to find that Professor Wood (*Science*, May 16) regards my amendment as only increasing the difficulty. It may be that I have been misunderstood: permit me, therefore, to answer the questions which the professor goes on to ask in illustration of this difficulty. Assuming (of course, correctly) that my answer to the question is, that it takes time to produce a change in the rate of motion, he asks, "How long is this interval?" I answer, "As long as you please usually: of course, the longer the interval, the greater the change." — "If ever so small, is the rate variable during the interval?" — "Certainly." — "If variable, the original question arises, and we wish to know if *change* involves *a part* of the interval." — "Of course, a part of the change takes place in a part of the interval, and the rest of the change takes place in the rest of the interval." — "Does change in the rate take place at 'a point' in the path, or during 'a space' of the path?" — "During 'a space' of the path; that is, while the point is passing over a space of the path." — "If at 'a point,' is it not equivalent to asserting that a change takes place in no time? [Most certainly it would be, but we do not assert this at all.] And if an interval is necessary, must it not be conceived as infinitesimal?" — "By no means: if you want a finite change, and that is what is usually meant by a change, you must take a finite interval of time; but, if you insist on introducing the conception of an infinitesimal change, you must admit also an infinitesimal interval of time." Let us put precisely parallel questions with respect to the *position* of a moving point. Does change of position take place at an instant, or during an interval? During an interval. How long is this interval? That depends upon the amount of change of position you desire to produce. If ever so small, is the position of the point variable during the interval? Certainly, if the point moves. Does change of position take place at a point in the path? Certainly not: a point has position, but no magnitude.

If there is any difficulty in conceiving the velocity of a point to be continuously variable, there is precisely the same difficulty in conceiving the abscissa of a point moving on the axis of x to be continuously variable; in other words, in conceiving the possibility of motion itself. It should be remembered that the definition of the measure of a variable velocity, presupposed in this discussion, is simply that which we find in such treatises as Tait and Steel's Dynamics of a particle: "Velocity is said to be variable when the moving point does not describe equal spaces in equal times. *The velocity at any instant is then measured by the space which would have been described in a unit of time, if the point had moved on uniformly for that interval with the velocity which it had at the instant contemplated.*" WM. WOOLSEY JOHNSON.

Annapolis, May 19.

Pleuracanthus and Didymodus.

In your issue of April 11, my friend Professor Gill communicates his views on the relationships of Pleuracanthus and Chlamydoselachus, and endeavors to correct some of my opinions and statements. On some points I stand corrected, thanks to Professor Gill's superior knowledge of the literature of the subject. However, as Professor Gill has not seen my material, nor the paper which I read before the Philosophical society upon it, I may, in turn, enlighten him on some important aspects of the case.

Professor Gill objects to the identification of the genera Didymodus and Chlamydoselachus on the sole ground of the diversity in the form of the teeth. He probably has other reasons for objecting; but, with his usual magnanimity, he has not used his most effective weapons. He doubts the pertinence of the recent and extinct genera to the same order. He points out that the oldest name of the genus called Diplodus is Pleuracanthus, and that my order Ichthyotomi has been already defined and named by Lütken as the Xenacanthini.

On these positions, I make the following comments: —

1. There is no generic difference to be detected, in my opinion, between the teeth which are typical of Diplodus Agass. and Thrinacodus St. J. and W. and the recent Chlamydoselachus. Differences there are, but apparently not of generic value. The identification of the recent and extinct genera rests, as far as this point goes, on the same basis as that of the recent and extinct Ceratodus.

2. At the time of my proposal of the name Didymodus, I was not convinced that fishes of this type bore the spines referred to the genus Pleuracanthus Agass. None of the authors cited figure any specimens which present both tricuspidate teeth and a nuchal spine. None of my ten specimens possess a spine. However, Kner describes two specimens as exhibiting both tricuspidate teeth and a spine, and Sir P. Egerton's statements (*l.c.*) on this point are positive. So we must regard Pleuracanthus as the name of this genus, with Diplodus as a synonyme.

3. Diplodus being regarded as a synonyme of Pleuracanthus, it follows that Chlamydoselachus Garm. is distinct on account of the *different structure of the dorsal fin*, which is single and elongate in Pleuracanthus, according to Geinitz and Kner. The presence of the nuchal spine in Pleuracanthus is also, probably, a character of distinction, although we do not yet know whether such a spine is concealed in Chlamydoselachus or not.

4. The identity of Didymodus (type, Diplodus compressus Newberry) and Pleuracanthus may now be questioned. None of the specimens are figured and described by the authors above cited, as displaying an occipital condyle, or posterior frontal cornua. My specimens of Didymodus compressus do not exhibit

teeth on the roof of the mouth, as Kner describes. There are no spines with the crania, although separate Pleuracanthus spines are not rare in the same beds. The teeth associated with the skulls, moreover, present a button on the superior side of the root. Agassiz figures teeth of this kind as belonging to the Diplodus gibbosus. St. John and Worthen make these teeth typical of Diplodus, and confer the name Thrinacodus on those without the button. The button is, however, probably only a specific character. The latter name is, then, probably a synonyme of Pleuracanthus. The button-bearing teeth are figured and described by Kner as occurring scattered, and at a somewhat different horizon from that of the Pleuracanthus specimens. In Germany, as in Texas, the button-bearing teeth are the larger. I suspect that the skulls I describe represent a different genus from Pleuracanthus proper. This genus will not differ from Chlamydoselachus Garm., so far as we know the latter; but the button indicates another species.

5. Of course, a study of the anatomy of Chlamydoselachus, which I hope Mr. Garman may soon give us, may reveal differences between that genus and Didymodus; but of these we know nothing as yet.

6. The order Xenacanthini was proposed by Geinitz (Dyas) for Pleuracanthus on account of the supposed suctorial character of the ventral fins. This character is supposed by Kner to be sexual. In any case, this division, whatever its value, must be subordinated to the order Ichthyotomi, as I define it.

E. D. Cope.

THE GOVERNMENT, AND ECONOMIC ENTOMOLOGY.

A fourth bulletin of the entomological division of the department of agriculture has just appeared, containing four reports, either by persons not closely connected with the department, or by its *attachés* sent on special missions, together with extracts from the miscellaneous correspondence of the division. The latter is of variable and generally insignificant value, and would have better been printed in small type: it might have been further curtailed by the omission of some absolutely worthless verbiage, though we recognize that less extraneous matter appears than has been customary in the reproduction of similar correspondence in the annual reports. Of the special reports, the most valuable is that of Mr. J. B. Smith on hop and cranberry insects, of which he mentions seven or eight species as attacking each plant. The least valuable is Mr. Branner's report of his mission to Brazil in the interest of the division. Being, apparently, only a temporary document, and valuable almost entirely for departmental purposes, it was quite unnecessary to publish it: on the other hand, if this is all that is to appear, his expedition must be deemed a failure.

The issue of these bulletins — an innovation in the practice of the department — indicates a laudable intention, on the part of the commissioner, to publish with promptness reports of its special agents upon particular topics. Since this cannot fail to stimulate those engaged in its work, and to enhance the value of the division in the eyes of our large agricultural population, it deserves commendation. We venture to suggest that the plan could be improved by issuing the bulletin at stated intervals, and making it a periodical, to which contributions from all quarters should be invited. All the entomologists of the country might thus become collaborators of the department without further cost to the treasury than the publication of the results of their researches: it would prove a credit to the bureau, a vast encouragement to economic entomology, and a boon to our agriculturists. The former experience of the present head of the division renders him an eminently fit person under whom to inaugurate such a plan.

In few countries in the world would such a plan be more desirable, more advantageous, or more likely to succeed. Covering, as our country does, a wide extent of fertile territory subject to most varied climatic conditions, and hence embracing unusual diversity of economic problems, our people are at the same time extremely ready to contribute their knowledge or experience, without compensation, for the public weal. Americans are not always anxious for precedents; yet, if precedent is demanded, the *Annales de la science agronomique* (just published under the auspices of the minister of agriculture), the various reviews, such as the *Revue des sociétés savantes* and the *Bibliothèque de l'école des hautes études* (long published by the minister of public instruction), together with the *Revue maritime et coloniale* (issued under the direction of the minister of marine), show what France alone has done, in similar ways, for science and industry during the past twenty-five years. It is time our government supported similar aids to material and intellectual growth.

In harmony with this plan, a further extension of the work of the division would prove desirable. Why would it not be feasible to district the country (omitting the sterile portions) into, say, half a dozen great areas, based on the geographical distribution of the main agricultural products and on climatological factors, and permanently locate, at some convenient centre in each, skilful assistants of the division to study *on the spot* the history and devastations of noxious insects? It is as impossible to do this work at Washington as to do that of the coast-survey or the geological survey, each of which has permanent establish-

ments in various parts of the country. A skilled entomologist at such a centre, with one trained assistant whom he might despatch to study local problems not far distant, would accomplish more than twice that number could on the border of the continent, whence the assistant must often travel many thousand miles to reach a field requiring investigation, and be able to remain there only a brief period. The state entomologists are not numerous enough to affect the question in the least. Illinois and New York alone support officers who are doing a really creditable work; and these great states, rich, populous, and fertile, would be insufficiently served, under this scheme, without the aid of their own officials.

This would require a doubled, perhaps a trebled, appropriation for the division. What of that? Its work should be measured, not by what it has been able to do with insufficient means, but by its inherent importance to the largest and most wide-spread industry in the country. A trebled allowance, multiplied a thousand-fold, would not equal the losses yearly sustained by agriculture, reasonably to be classed as avoidable by means which the study of their causes will reveal. The work of the division for the past six years has been admirable, as far as it has gone: it has gained the approval of those who know what scientific work is, and the appreciation of the great class who have seen its practical benefits. It is time to ask, and to grant, the means for a forward step.

RECENT GEOLOGICAL OBSERVATIONS IN THE CANADIAN NORTH-WEST TERRITORY.[1]

IN a former number of *Science* (i. p. 477) a note was given on some points relating to the glaciation of that part of the North-West Territory which occupies the angle between the eastern base of the Rocky Mountains and the 49th parallel. During the summer of 1883 the examinations necessary for the production of a proximately exact geological map, covering an area of over twenty thousand square miles in this district, have been completed, and the mapping of the contiguous area to the eastward has been begun. A number of new facts of geological interest have been brought to light during the prosecution of the work, a few of the more important of which it is proposed here briefly to mention.

In the article above alluded to, the great elevation at which Laurentian and Huronian erratics occur near the mountains was specially noted; and some of the greatest heights up to that time observed were stated as 4,200, 4,390, 4,660 feet, respectively, above the sea-level. In August last, however, several indubitable Laurentian bowlders, representing different characteristic varieties of gneissic and granitic rocks, were found at an elevation of 5,280 feet, at a point in the foot-hills about twenty miles north of the 49th parallel. The ridge upon which these occur lies within a few miles of the paleozoic rocks of the mountains, and, like many others in this vicinity, is evidently a slightly modified moraine, due to the local glaciers of the mountains. The bowlders are associated with many blocks derived from the neighboring mountains. They cannot, however, have come from the Rocky Mountains, as a tolerably complete examination of the range, between the 49th and 51st parallels, has confirmed the statement, previously made in a more general way, as to the absence of crystalline rocks in the constitution of the range: their origin must therefore be sought, with that of the immense profusion of similar erratics strewn over the neighboring lower country, to the east or north-east, in the great Laurentian axis.

In the Cypress Hills (latitude 49° 40′, longitude 110°), which constitute an isolated, high plateau of irregular form, Mr. R. G. McConnell has noted some interesting points connected with the limit in height of the drift and bowlder deposits. The western end of the hills is highest, and is flat-topped and regular in form; while the eastern and lower part has been worn down to an irregular, rounded, and rolling plateau, on which numerous Laurentian and limestone bowlders, resembling those generally scattered over the plains, occur. The highest point at which these were found is 4,340 feet above sea-level; while at 4,400 feet, and other points exceeding this elevation, no such erratics occur. From the observations first referred to, it is certain that this, though locally the upward limit of the glacial deposits, is surpassed by that of other places farther to the west; and it adds to the evidence already obtained, indicating an unequal depression of the plains in glacial times.

In these hills another very interesting discovery has been made by Mr. McConnell; viz., that of the occurrence of considerable outlying areas of an upper tertiary formation of miocene age, consisting, in large part, of rolled shingle which has been derived entirely from the harder rocks of the mountains. The peb-

[1] Communicated, in advance of publication of report, by permission of the director of the Geological survey of Canada.

ble-beds, or conglomerates, are frequently composed of stones several inches in diameter; and as they occur at a distance of over two hundred miles from their nearest possible source, and no signs whatever of ice-action appear, the problem of their mode of transport becomes a difficult one. A few vertebrate remains obtained from these beds appear to be referable to Brontotherium.

It may be mentioned, in this connection, that the discovery of these tertiary pebble-beds to some extent tends to modify statements previously made, respecting the origin of somewhat similar shingle-deposits of later date in this vicinity. The transport of a portion, at least, of the quartzite shingle immediately underlying, and apparently attached to, the bowlder-clay, may have occurred in the miocene period, and its denudation and rearrangement been effected in early glacial times. Of the older formations in this part of the north-west, the following classification has been adopted: —

Laramie.	Porcupine-Hill beds. Willow-Creek beds. St. Mary River beds.
Cretaceous proper.	Fox-Hill sandstones (inconstant). Pierre shales. Belly-River series. Dark shales, supposed to underlie the above.

The subdivisions of the Laramie appear to be of local importance only, but are useful in the region here specially referred to, on account of the very great thickness of that formation. The upper part of the Belly-River series evidently represents the pale, sandy beds which occur on the Missouri in a similar position with reference to the Pierre; and the latter holds coal or lignite at the base in this district, as described by Prof. E. D. Cope on that river. In 1881 the lower portion of the Belly-River series, characterized by yellowish and brownish tints, was found to be highly fossiliferous, and to hold shells like, and in some cases conspecific with, those of the Judith-River group. In consequence of this fact, some doubt was felt in accepting the evidence of the apparent stratigraphical position of this portion of the series; and a re-examination of the district was made with the object of deciding this point. The result of this further investigation has been, however, to confirm the views first held by much additional stratigraphical evidence, which cannot here be detailed, and, further, to prove the existence in the upper or pale beds of the Belly-River series of a molluscan fauna of the same kind with that characterizing the yellowish beds above referred to. The sections are such that no doubt could at any time be entertained with regard to the relative positions of the Pierre and the pale beds.

The composition of the cretaceous, here found to obtain, is thus brought into exact parallelism with that clearly proved in the Peace River country (Report of progress, 1879–80), where a similar important estuarine series, with Laramie-like fossils, follows the Pierre in descending order. The fossils of the Belly-River series have not yet been critically examined; but their resemblance to those of the Judith River is so complete, that I am strongly inclined to revert to Messrs. Meek and Hayden's original views respecting the stratigraphical position of the latter beds,[1] and to suggest, though with some hesitation, that the species figured on plates 37–39 of Meek's work on the cretaceous and tertiary fossils of the Upper Missouri, as from a peculiar local development of the Fox-Hill group, have really been derived from beds underlying the Pierre. One at least, of these fossils (Mytalus subarcuatus), has been found in our district in this position.

The occurrence, among the paleozoic rocks of the portion of the Rocky Mountains between the 49th parallel and Bow River, of extensive cretaceous areas on both sides of the main watershed, is an interesting addition to our knowledge of the range, and important because of the contained coal-seams, which vary in character from bituminous and coking coals to anthracite. A coal of the latter class, containing eighty-six per cent of fixed carbon, was found last summer in the valley of Cascade River, on the Upper Bow; and mining operations have already been commenced on it. The trough of cretaceous rocks is here comparatively narrow, and the beds very sharply folded.

Space will not permit any detailed notice of the investigation of the paleozoic rocks of the mountains. It may be stated, however, that the limestones appear, for the most part, to be of Devonian age, and are very variable in thickness. One measured section on the Crow-Nest Pass showed a thickness of ninety-six hundred feet. They are unconformably underlain by a great series of slaty and quartzite rocks, from which no fossils have yet been obtained in place. On the evidence of detached fossiliferous fragments, they are, however, provisionally referred to the Cambrian, and closely resemble, lithologically, those of this age in the Grand Cañon of the Colorado.

GEORGE M. DAWSON.

Geological survey of Canada, Ottawa.

[1] *Proc. acad. nat. sc. Philad.*, 1857, p. 114.

FIVE BRAZILIAN DIAMONDS.

At the International exposition held at Amsterdam during the summer of 1883, was exhibited a suite of wonderful round diamonds, that, for their size and merit, were awarded the prize for 'round bort.' They were purchased by a New-York firm, who offered them to Messrs. Tiffany & Co., and, on examination, were found as follows: —

They are of Brazilian origin, four in number, and all as round as marbles. In this form they can be used for drilling-purposes to equally good advantage with the black amorphous carbonado, as the intricate twinning or compounding destroys the easy cleavage property that renders ordinary crystals unfit for this purpose.

No. 1 (fig. 1), the largest diamond, is entirely round, of a light vitreous brown color, and translucent; its entire surface being covered with small re-entering angles, giving it the appearance of the fibrous, or, rather, bunched crystals of acicular rutile, variety nigrine, from Magnet Cove, Ark. These markings, numbering hundreds, are over the entire surface, and render it very evident that the crystal is the result of a multiplicity of twinnings of cubic crystals, as is often the case with iron pyrite. It is 17 millimetres in diameter, and weighs 8.542 grams ($41\frac{3}{4}$ carats); specific gravity is 3.51954.

No. 2 (fig. 2) is entirely round, of a milky gray color, and translucent. To the eye the surface appears quite smooth; but under the glass the same markings show, on a smaller scale, as in the large diamond, though the surface is duller. It is 10 millimetres in diameter, and weighs 2.0815 grams ($10\frac{7}{32}$ carats); specific gravity is 3.522.

No. 3 (fig. 3) is almost entirely round, of a milky, translucent white, no crystalline markings being visible, and has a fused vitreous appearance, as if it had been originally round, with small pit-markings, and then the entire mass fused, thus nearly obliterating the pitting. It is 9 millimetres in diameter, and weighs 1.289 grams ($6\frac{5}{8}$ carats); its specific gravity is 3.5218.

No. 4, the weight of which was 1.478 grams, and its specific gravity 3.649, proved, on examination, not to be a diamond, but a red hematite sphere that had been rolled, and was evidently a pseudomorph after limonite or some other like mineral, or was filled with air-cavities (see low specific gravity). Not coming into ownership of it, I could only try the surface, whereas, if it could have been broken, more definite results might have been arrived at.

It seems very remarkable, however, that this specimen, having been viewed by the majority of the Amsterdam diamond-dealers, examined by the judges and experts, and then passed through the hands of several old and experienced importers of diamonds, should have deceived them all. So perfect was its color and lustre, that even a diamond-cutter, when informed of the facts in the case, was not convinced until he had tried the stone on the wheel.

Another curious diamond (figs. 4 and 5) is now in possession of Messrs. Tiffany & Co., weighing $6\frac{3}{32}$ carats, the original weight of which was $10\frac{1}{2}$ carats, 4 carats having been lost

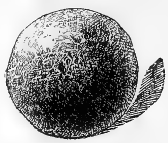


Fig. 1.

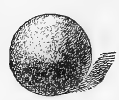


Fig. 2.

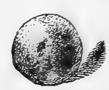


Fig. 3.

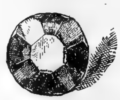


Fig. 4.

Fig. 5.

Fig. 6.

in cutting. This stone has eighteen facets, of which four, of the top and the table, are white, and four are a distinct black; on the back, four facets are white, and the other four and the culet are black. The stone was found to be excessively hard, much above the average of hardness, in fact; and, although apparently poorly cut, the cutter had sustained a loss, owing both to the longer time required in the work, and also to the fact that he was remunerated at a certain rate per carat. This diamond is of Brazilian origin, and was originally an octahedron. When found, the entire stone was a jet black, and it was cut with the intention of producing a black stone. After the table had been put on one of the points, and the four edges of the octahedron had been removed to make four facets, it was found that the black color was only a superficial coating, and that the inside of the crystal was entirely white, with the exception of an occasional carbon inclusion. It shows no more play of color than a black stone, but gives very decided brilliant metallic reflections. The curious effect of five white and four black reflections, and the appearance of a clearly defined Greek cross in black outline, when viewed by transmitted

light, make the stone a remarkable freak of nature; and not a little interest is added to it by the fact that its strange features were so well developed by mere accident.

Among curiously marked diamonds resembling the above, may also be mentioned the two presented to the Jardin des plantes by Halphen, and described by Descloizeaux (see *Poggendorff's annalen*, 1849, ix. p. 447).

These stones are colorless and round, and a distinct three-leaved clover in black occupies the entire dimension in each stone. Another in the Duke of Leuchtenberg's cabinet, now in the Bavarian state cabinet at Munich, has three leaves united by a circle. All these three are of Indian origin.

A curious diamond (fig. 6), also in the possession of Messrs. Tiffany and Co., is a red brilliant, that at first glance appears brown, while through it a beautiful dark rose-red light breaks in every direction: really, therefore, it is a red brilliant, or combination of red and brown; or, more correctly, a red diamond with a brown cloud, the red predominating as the stone is turned, or the light strikes it in different directions. This change of color gives the stone its dichroitic effect, although no effect is produced in viewing it by the dichroscope.

By artificial light it appears brown; but the entire stone throws out bright red reflections, such as are produced by the diamond only.

One-half of the stone is filled with hundreds of irregular-shaped cavities, either empty, or filled with a transparent fluid, or, as in nearly all cases, with carbon, which in some instances is in pieces, or so fractured as to admit the light through it. These inclusions appear to affect the color sufficiently to produce the brown appearance.

Light seems to be very faintly restored under the crossed Nichols prisms, in addition to that produced by the cutting of the gem. The specific gravity is 3.5696. GEORGE F. KUNZ.

THE DISTRIBUTION OF COMETS WITH REFERENCE TO SOLAR MOTION.

THE regions of space outside the solar system furnish a supply of comets which seems to be inexhaustible. Their origin is simply a matter for speculation; and it is not reasonably to be expected, that, even with the large amount of attention being given to cometary investigation, any definite information upon this subject can be attained for centuries to come. There is no probability that any considerable number of them have had their origin in the mass which has gone to form the solar system.

Between six and seven hundred comets have been recorded; and if we take the large proportion of telescopic comets which have been discovered when searching has been vigorously prosecuted, to the number visible without the aid of a telescope, it would not be an exaggerated estimate to place the number of comets which have come into our system since the beginning of the Christian era, under such conditions as to have been visible by the aid of our modern appliances, at four thousand.

Undoubtedly there are many, which, either from their small size and faintness, or from the unfavorable positions of their orbits, never could be seen. Were the orbits of all these known, the discussion would furnish some reasonable basis for an hypothesis in regard to the origin of the comets themselves; and light would be thrown upon other problems concerning the system of the universe.

While the sun, drawing all bodies within its influence towards itself, swings the comets into orbits which may bring them, at some point, almost into contact with the sun's surface, or, on the other hand, never within the confines of our planetary system at all, the motion of the sun itself must have an influence upon the position of these orbits. The limited amount of material at hand furnishes some features which are at least suggestive.

There are two hundred and eighty-five comets, which, up to the present time, have had their orbits determined with greater or less exactness. The axes of the orbits lie in the directions along which the comets come to the sun.

The table exhibits the grouping of the points which represent the directions of the origins of these comets about that point which investigation has indicated as the direction to which the solar system is moving.

The method of making the reductions will be apparent. The elements were reduced to 1850, and the longitude and latitude of the perihelion point computed for each comet. The point directly opposite this was then reduced to a new system of co-ordinates, having the direction of solar motion, as the pole.

The point toward which the sun is moving is taken at longitude 256°, latitude +57°.

For convenience this may be referred to as the north pole of the new system; and the hemisphere surrounding it, as the northern. This hemisphere is then divided into ten zones of equal area, the most northern surrounding the pole, while that at the base may be called the equatorial.

The southern hemisphere is similarly divid-

ed, and in the table the figures in the top line are for the north and south polar zones.

Those adjoining each are given next, so that the lower line contains the zones immediately north and south of the equator. Zones on the same line are at the same distance from the north and south poles respectively.

The columns give the number of comets whose points of apparent origin fall in each zone, and the mean of the perihelion distances of the group.

North.		South.	
No.	Mean perihelion distance.	No.	Mean perihelion distance.
9	0.730	16	0.599
8	1.022	13	0.713
13	0.745	14	0.715
12	0.700	13	0.526
15	0.838	28	0.795
14	1.010	11	1.008
20	0.821	17	0.813
11	0.903	10	1.091
19	0.767	12	0.789
15	0.762	15	0.912

So many conditions that will readily occur to any one come in to affect the number of comets discovered, and, to a certain extent, the discovery of those coming from any particular quarter, that the collection of so small a proportion cannot give much satisfaction. It will be noticed that the zones farthest south have a larger number than the corresponding zones north, while near the equator this difference is reversed.

The mean perihelion distances, taking the columns separately, vary in such a way that there is little encouragement for discussion as a whole.

But taking the corresponding zones in the two hemispheres, the comparison is interesting, if not instructive. The first seven from the north pole, or direction of solar motion, downward, have greater mean perihelion distances than those in the southern hemisphere similarly situated. The equatorial zones, where the distinction would not be so great, have an opposite difference.

With the same data combined in other proportions, the differences will be found to confirm the tendency shown by this division. Thus doubling the area of the zones, making five northern and five southern, the excess of mean perihelion distances of the north over the south exists in the three polar sets. Comparisons can also be made by fours and fives, and also by combining the two adjacent to the polar zones, the three next following these, and finally the four next north and south of the equator. Any one can make these comparisons with small uncertainty, from the table.

The most satisfactory confirmation of the tendencies here indicated is found in the discussion of the comets of the last hundred years only. These have been well observed in general, and the number does not contain so large a proportion of anomalous orbits. The table above includes all, probably, that have been computed; but, in summing up, notice was taken of the effect of the unusual cases, like the large perihelion distance of the 1729 comet, and the combination of several very small distances in one zone; and in no case would the sign of the compared difference have been changed by the omission of any extraordinary comets.

For the one hundred years the numbers in the zones are more uniform, with a similar tendency to that above.

In the comparison of perihelion distances by zones, seven of the northern exceed the corresponding southern.

The general results may be summed up in a few lines. There is an indication that more comets come in from the hemisphere from which the sun is moving.

The zones in the hemisphere towards which the sun is moving, and which has for its pole the direction of solar motion, have in general greater perihelion distances than the corresponding zones in the other hemisphere; the tendency being best exhibited as we go from the equator of the system.

As the sun moves on, the comets at great distances would come into the system, eventually, behind the quarter in which they first yielded to the attraction. Under the same general conditions, those which have come from behind the sun, and have been, as it were, dragged in its train, would pass nearest to the point of attraction when overtaking it.

These are the suggestions which most naturally occur. A complete discussion of the effect of the solar motion upon the distribution of comet-origins can hardly receive any decided confirmation with the amount of material that is likely to be available for generations to come.

R. H. TUCKER, Jun.

Lehigh university.

VOLCANIC SAND WHICH FELL AT UNALASHKA, ALASKA, OCT. 20, 1883, AND SOME CONSIDERATIONS CONCERNING ITS COMPOSITION.

MR. APPLEGATE, the signal-service observer at Unalashka, reports that on the 20th of

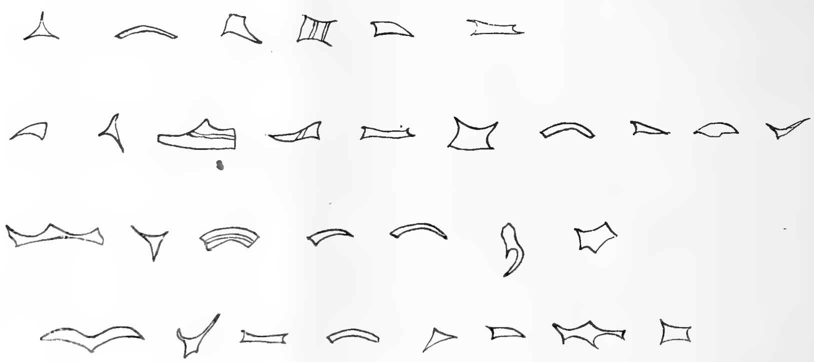
October, 1883, about 2.30 P.M., the air became suddenly darkened, like night; and soon after, a shower of mixed sand and water fell for about ten minutes, covering the ground with a thin layer. The windows were so coated that it was impossible to see through them. A small portion of the sand was referred to me for microscopical examination; and, at this time of general concern in atmospheric dusts, it may be well to note the products of one of the Alaskan craters, which for some time has been in a state of more or less vigorous activity.

The sand is composed chiefly of crystalline fragments, of which felspar is the most abundant. It generally occurs in irregular, angular splinters, but not infrequently in well-preserved crystals with large inclusions and a distinct zonal structure. These crystals are slightly tabular, parallel to the clinopinacoid, and, lying on that plane, they present an approximately hexagonal outline, about 0.15 of a millimetre in diameter. Lath-shaped felspars, so abundant in basalts, were not observed. A few thin cleavage lamellae, with parallel extinction, showed no banding due to polysynthetic twinning; but by far the greater portion of the fragments, in polarized light, were distinctly striated. The pale green augite appears usually in the form of broken prisms; and the deep brown, strongly pleochroitic hornblende, which is less abundant than either the augite or felspar, occurs for the most part in cleavage plates. Irregular grains and crystals of magnetite complete the list of minerals which form an essential part of the sand. Crystal fragments of the minerals already mentioned constitute the largest portion of the sand; but, besides these simple grains, there are others complex in their nature. They correspond to the groundmass of a porphyritic rock, and are composed of an amorphous base, containing a multitude of microlites. Very rarely particles of clear volcanic glass may be found, and they are generally freighted with grains of magnetite. The grains of sand are fresh, and it is undoubtedly of recent volcanic origin. Its mineralogical composition is that of a hornblende andesite. Mr. Chatard of the U. S. geological survey, who made a partial analysis of the sand, found 52.48 % of silica,—an amount which is certainly much below the average for hornblende andesite. This paucity in silica, as well as in glassy particles, may be readily comprehended by considering the origin, composition, and distribution of volcanic sand and dust.

Among the various sands and dusts examined and compared for the purpose of seeking an explanation for the poverty of silica in the sand from Unalashka, is one collected about a dozen miles north-east of Mount Shasta, in northern California. This sand is considerably coarser than that from Unalashka, and is composed chiefly of crystal fragments of felspar, augite, hypersthene, hornblende, and magnetite, with particles of microlitic groundmass, and considerable pumiceous glass. The mineralogical composition of the sand is the same as that of the hornblende andesite which issued from the prominent and well-preserved crater named, by Capt. Dutton, Shastina, upon the north-western flank of Mount Shasta. There can be no doubt that the sand was ejected from Shastina, for all the other craters of that region have erupted different material. Mount Shasta itself has effused hypersthene andesite, and the smaller craters to the eastward have furnished basalt. According to Mr. Chatard's analyses, the sand contains 60.92 % of silica, while the Shastina lava, to which it belongs, contains 64.10 % of silica.

As far as definite observations upon this subject have been made, it appears to be true,

SERIES 1.
" 2.
" 3.
" 4.



in general, that volcanic *sand* is composed chiefly of crystalline fragments, and contains a lower percentage of silica than the lava to which it belongs. With volcanic *dust*, however, the case is very different. That which fell in Scandinavia, March 29 and 30, 1875, after having been carried by the wind from the great eruption in Iceland a distance of at least seven hundred and fifty miles, was composed almost exclusively of irregular, angular particles of volcanic glass. Through the kindness of Professor Rosenbusch, in Heidelberg, I have obtained various samples of volcanic dusts for comparison. In the accompanying figures, series 1 represents the acute, angular, curved-sided fragments which are common in the Norwegian dust. In an excellent article by Murray and Renard, which appeared in *Nature*, April 17, 1884, p. 585, the forms of vitreous particles of Krakatoa dust are represented. It is undoubtedly true that the shapes represented are those which prevail in volcanic dust, but they appear to be less characteristic than the curious outlines of fragments from the same dust given in series 2. In the succeeding series (3) are outlined the less common fragments in rhyolitic dust, collected by Mr. I. C. Russell along the Truckee River, in western Nevada. That these acute, angular, curved-sided forms are the most characteristic ones of volcanic glass particles, is impressed by a study of old tufas, in which the glass, originally mixed with other clastic material, is completely replaced by quartz. An interesting tufa of this kind occurs at Breakheart Hill, Saugus, north of Boston. Where vitreous fragments of the most common shapes are replaced by another material, the pseudomorph does not always suggest the original constituent; but when we find such forms as are represented in series 4, from the Breakheart-Hill tufa, there can be but little question as to the original presence of volcanic glass.

Krakatoa dust which fell at Batavia has been analyzed by Mr. Renard, and found to contain 65.04 % of silica, while the pumiceous form of the same lava, according to Mr. Iddings, contains only 62 % of silica. It is well known that volcanic dust is composed chiefly and essentially of minute particles of natural glass; and, so far as definite observations have been made, they warrant the general assertion, that with occasional exceptions, which can be readily explained, volcanic dust contains a higher percentage of silica than the lava to which it belongs.

Volcanic sand and dust must be regarded as differing, not merely in the size of their particles, but also in their physical and chemical constitution; sand being composed, in the main, of crystalline fragments, and containing less silica than its corresponding lava, while volcanic dust is made up chiefly of glassy particles, which have a higher percentage of silica than the magma from which they were derived. Between these two extremes there are, of course, all possible intermediate terms; but, nevertheless, it is evident, that, as a result of the operation of natural causes, there is a decided tendency, in connection with violent eruptions, to separate the magma into a basic and an acidic portion. The degree of separation ultimately attained depends upon the final influence of the atmosphere upon their distribution. Under favorable conditions, the dust may be spread many hundreds of miles from its source, while the sand is scattered within a comparatively small radius; but, under less violent and favorable conditions, both may be precipitated near the crater from which they issued.

The inception of this divisional process is to be found in the condition of the magma before its eruption. It is well known that crystals are frequently, and sometimes abundantly, developed in a magma; so that, before its extrusion, the magma may be regarded as made up of a crystalline, solid portion, and an amorphous, more or less fluent portion. These are generally thoroughly intermingled, but occasionally they are arranged, as in obsidians, in alternating bands; and they differ from each other in several important particulars, besides those already mentioned. The earliest products of crystallization are basic minerals, such as the ores of iron, hornblende, and mica; and, as the process continues, the amorphous portion of the magma becomes more and more siliceous. On this account, the crystalline portion of the magma does not contain as high a percentage of silica as that which is amorphous. Capt. Dutton, in his researches upon the volcanoes of the Hawaiian Islands, made the interesting observation, that, at the moment a magma solidifies, a large quantity of vapor of water is given off. In the process of crystallization, the gases absorbed in the magma are rejected from the crystallizing substances, and accumulate, under enormous tension, in that portion which is amorphous. In this manner, the non-crystalline portion of the magma becomes stored with explosive compounds, under such stress, that, when the pressure is relieved, they may blow it to fine siliceous glass-dust; while the crystalline, solid, basic portion of the magma, pulverized rather

by external than internal forces, is reduced to sand.

It is doubtless true that a part of the volcanic sand and dust results from the trituration of solid material in the process of violent eruption; but, at the same time, it is generally believed that by far the largest portion of the latter is produced directly by the distention and explosion of multitudinous vesicles in the amorphous, viscous portion of the magma, and is the extreme product of the same operation which produces pumice. Mr. I. C. Russell has recently described some interesting volcanic dust from the Great Basin of Nevada. It has been traced two hundred miles from its source, the Mono craters, and has about the same chemical composition as the glassy lava of that place. This can be readily understood when we consider, that, at the time of its eruption, the magma contained few, if any, well-developed crystals. The difference in chemical composition between volcanic sand or dust, and the lava to which it belongs, appears to be directly proportional to the amount of crystallization which has taken place in the magma before its effusion. The composition of the Unalashka sand is such as to indicate that before its eruption there were many crystals secreted in the magma, so that there would be a proportionally small amount of siliceous dust produced. While it is evident that the constitution of volcanic sand is very variable from place to place, yet it is such in this case as to clearly indicate that it came from a crater erupting hornblende andesite, and that its basic character may be explained by supposing that the siliceous portion of the magma was carried away in the form of dust. The unaltered condition of the minerals and groundmass indicates that the sand has not been exposed to atmospheric influences for any considerable length of time, and favors the opinion of Mr. Applegate, that the sand came from the new crater, near the Island of Bogosloff, about sixty miles to the westward.

The precipitation of volcanic dust has been reported from several places in the United States, but it is all of very questionable determination. Mr. G. P. Merrill, of the U. S. national museum, has recently investigated that which fell at Rome, N.Y., and proved it to be an ordinary dust, composed chiefly of minute fragments of quartz and iron-stained products of decomposition. All of the reported dusts, of which I have been able to obtain samples, have been found to be like that which is most common about dusty cities and plains. A little experience will readily enable one to distinguish the Pélé's-hair and glass globules, in the dust of blast-furnaces and other iron-works, from the glass particles in volcanic dust.

The origin and distribution of the uncommon forms of dust are beginning to receive the attention they deserve; and it is a matter of gratulation, that the signal-service of this country has already taken steps towards systematic observations upon this subject at several elevated stations, such as Mount Washington and Pike's Peak, as well as in Alaska.

U. S. geological survey. J. S. DILLER.

METEOROLOGICAL CHARTS OF THE NORTH ATLANTIC.

ONE cannot fail, in studying the progress of maritime meteorology, to be impressed with the value placed on the Maury charts, as evinced by the frequency with which they have been copied, or have served as the basis for more extended work in foreign countries. But it is also to be noticed, that in recent years the tendency has been towards more originality and independence in the work of the several nations that take part in this branch of physical investigation; and, further, that while Maury's principle of exhibiting as far as possible the separate observations on which averages are based is retained, his plan of dividing charts according to topics has been replaced by the much more practical division according to time. The master of a vessel, beginning a voyage in May, does not care to find on his chart information about the winds of all the year, but prefers information of all kinds about May, and especially about the winds, calms, gales, squalls, and fogs of that month.

Having considered, in a previous article, the development of maritime meteorology as shown in the wind-charts of the North Atlantic, published by various foreign governments since Maury's time, it is with satisfaction that we can now turn to a work on the Atlantic, executed in our own country, in which the advance from the earlier styles of charting is as well marked as in any of the examples given above.

On the charts whose title is given in the note,[1] we find the atmospheric conditions over a large area shown with greater detail, and based on a larger series of observations, than in any other charts yet published. The number of observations is extraordinary. The chart for March alone has wind-observations for 211,057 hours. That part of the chart which corresponds to the six of Toynbee's ten-degree squares north of the equator has 63,846 hours: the

[1] Meteorological charts of the North Atlantic Ocean for the months of March, April, and May. Published June, 1883, at the hydrographic office, Washington, D. C. J. C. P. Dekraft, commodore, U.S.N., hydrographer to the bureau of navigation. Prepared under the supervision of Lieut. JOHN H. MOORE, U.S.N. Charts for June and July were published in March and April, 1884. T. R. Bartlett, commander, U.S.N., hydrographer.

same area in Toynbee's monograph has for March only 6,823 wind-observations. One of the five-degree squares (No. 676, latitude 0° to 5°, longitude 20° to 25°) into which the ocean is divided on our charts has 10,329 hours of record : this is practically equivalent to a continuous hourly record in this square for nearly fourteen Marches. If the other months maintain the same number of North Atlantic observations,

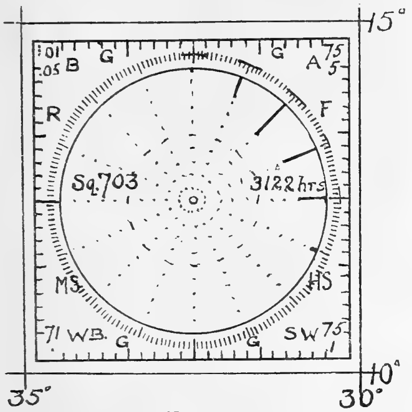


FIG. 1.

the year's average would be based on about 2,500,000 hours of record. On the other hand, many coast squares, and most of those off Newfoundland and Labrador, have insufficient observations. The wind-observations in this vast quantity of material come from the Maury records and from more recent logs in about equal number, but the data on the side of the squares rest on the recent logs alone.

Chief attention is given to classifying the wind in direction and force, as this is the factor of greatest use to the practical seaman. The percentage of the number of observation-hours during which the wind is recorded as having blown from every two points of the compass is shown by the fractional radius drawn inward from the appropriate part of the circle within the square. The average force for every wind-direction, in units of the U. S. navy (= Beaufort) wind-scale, is measured by the number of divisions, outside the circle. (fig. 1), connected by a cross-line. The percentage of calms and variable winds is shown on the radial percentage scale by a ring and a cross at the centre of the circle. North-west and north-east gales (G) are shown in percentages on the top of the square; south-west and south-east, at the bottom. Moderate squalls ($M S$) and heavy squalls ($H S$) are placed on the lower half of the left and right sides of the square, rain (R) and fog (F) being above them. All these are given in percentages of their total hours,[1] and consequently, when taken together, give to the navigator a very close measure of the kind of weather he may expect for any part of the North Atlantic south of 50° latitude. The figures in the corners of the squares record the average stand and the average daily variation of the barometer (B), air-thermometer (A), wet-bulb thermometer ($W B$), and sea-thermometer ($S W$), thus completing the list of the more important and practically useful climatic elements. The most serious omission is the number of observations on which these side data depend.

[1] The legend on the charts states that these side data rest on a smaller number of hours than is recorded for the general wind-observations.

The mechanical execution of the work is excellent. The charts, twenty-seven by thirty-four inches, are clearly and sharply engraved. The figures are, perhaps, rather fine, being smaller than in the accompanying cut, which does not fairly represent the clearness of the original, but they are not so fine as some in Toynbee's work; and some of the lines are too delicate for rapid reading, but they are perfectly distinct on a closer examination. Some ease of counting might be gained by emphasizing the fifty-per-cent divisions, as here marked. In comparing the graphic method of these new charts with the numerical and verbal form of record in the volume for the North Pacific,[1] issued by the hydrographic office a few years ago, it is difficult to make a choice, except as a matter of preference. The results shown are about the same in both. On the Pacific charts, from which a five-degree square is given in fig. 2, the number of observations, and average force of the wind for every two points, are given in the outer circle: the percentage that these observations make, of the total of winds, calms, and variables, is in the inner circle. The other data explain themselves. In the centre there is a verbal description of the characteristic local weather, for which there is no space in the Atlantic charts. But the frequency of gales from the four quadrants is not shown; and

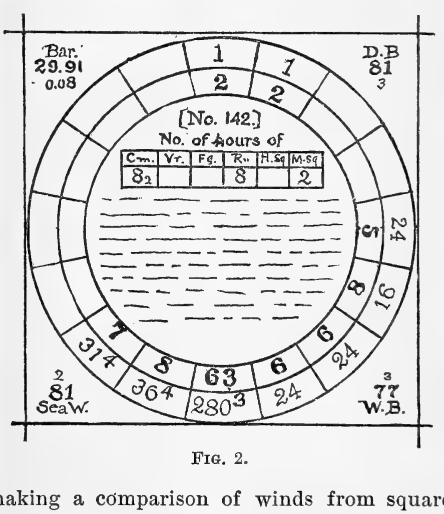


FIG. 2.

in making a comparison of winds from square to square, or even within a single square, the numbers have first to be read, and then compared; which is certainly more difficult than when the wind percentages and strengths are expressed in lines, whose

[1] Meteorological charts of the North Pacific Ocean from the equator to latitude 45° north, and from the American coast to the 180th meridian. Washington, 1878. (Prepared under the direction of Lieut. T. A. Lyons.)

relative length is quickly seized by the eye. When the subdivisions go down to one-degree squares, then tabulation is necessary to save space, if a variety of data is to be shown; but, on five-degree squares, we believe the general preference would be for graphic representation, unless, what would be still better, both methods were combined, somewhat as in Toynbee's charts; but this would increase the size of the sheets. After all, the choice between the two methods must be made, not so much by the reviewer, as by the practical seaman, for whom the charts are especially constructed.

Currents are not attempted on these charts: it is the intention of the hydrographic office to give them special study as soon as possible, with particular attention to the temporary and local winds at the time of every observation. It may thus be possible to explain the rather discordant results shown on many current-charts. Before this, however, it is the desire of the office to complete the meteorological charts for the other oceans, on the plan now so well carried out for the North Atlantic. All who are interested in the success of this long piece of work will join in the wish that every aid and opportunity may be given to its progress.

The accompanying figure (fig. 3) is inserted for comparison of these new charts with those of Toynbee's squares that they cover, for the month of March. The full lines are isobars, the fainter ones being Toynbee's. Their agreement in general attitude is good, but there appears to be a persistent difference of reading of one or two hundredths of an inch between the two. The broken and dotted lines are sea-water isotherms, with satisfactory coincidence. The arrows show the average winds: the only notable divergences are in the region of variables and calms. On attempting to draw out the isobars for the whole of our March chart, smooth curves can be traced up to latitude 30° or 35° by admitting corrections of two or three hundredths of an inch. Farther north, where observations are fewer, and barometric variations are known to be greater, corrections of five-hundredths or more are sometimes needed. This is probably due to the great difficulty of finding closely checked barometer records, especially in the older logs. Although all defective records have been thrown out whenever detected, it is evident that some still remain; as, for example, in square 786, on the March sheet. We may therefore infer that the next improvement in the study of oceanic meteorology will come rather through increased accuracy than through increased number of observations.

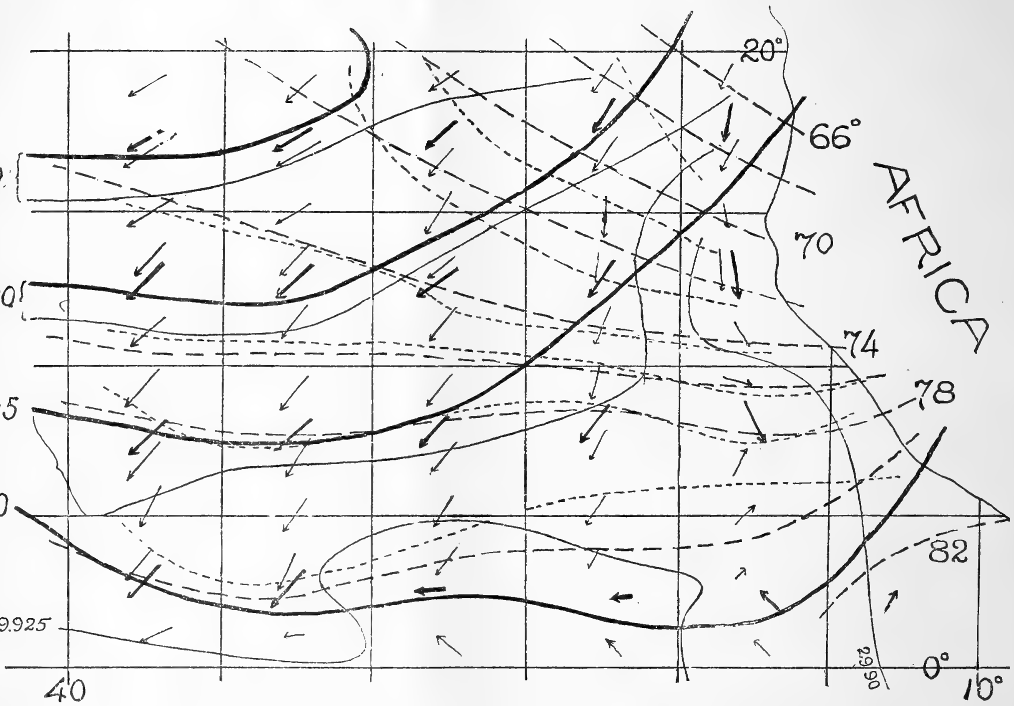
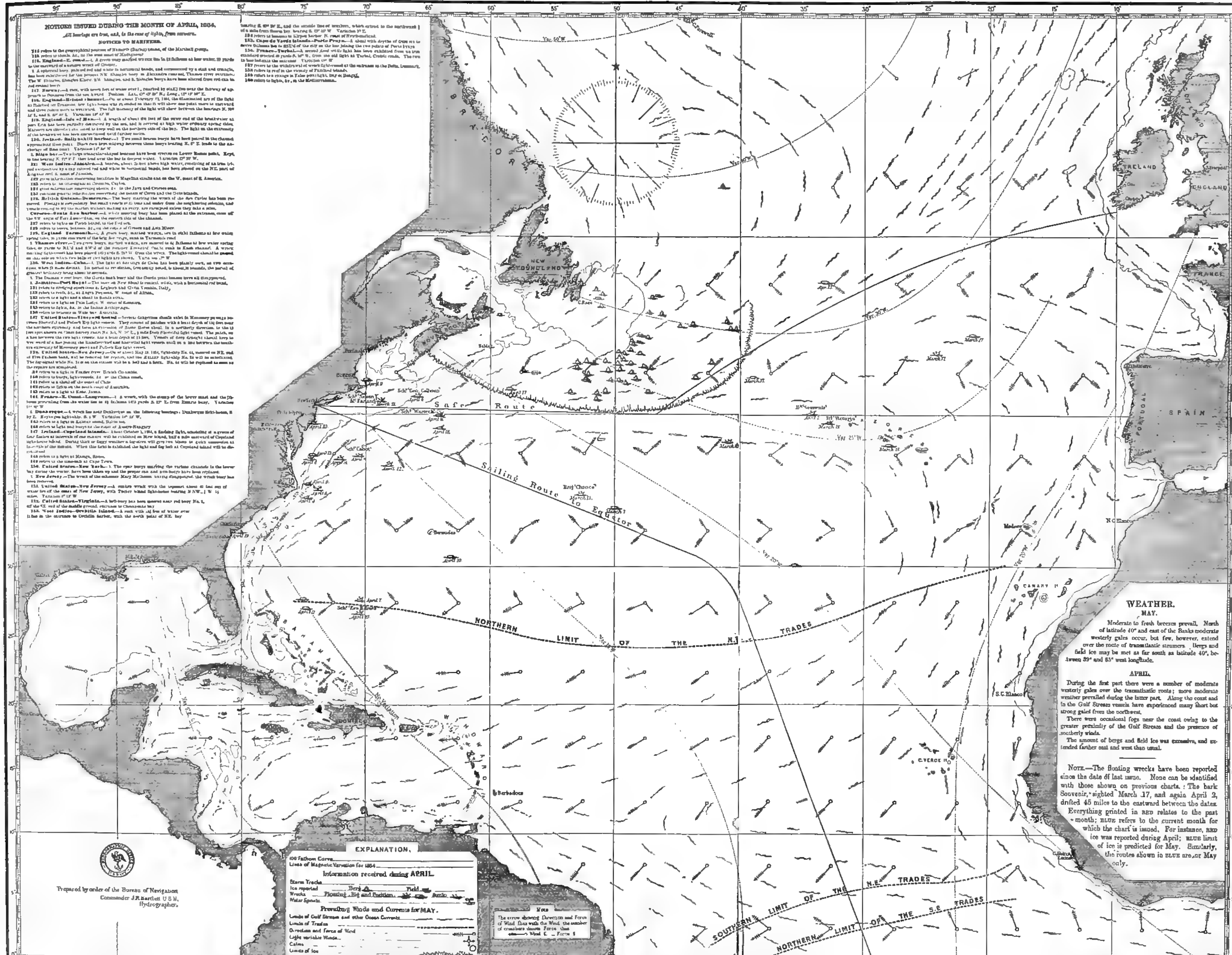


Fig. 3.

Another style of work undertaken by the hydrographic office is seen in the monthly Pilot charts of the North Atlantic, begun last December, of which mention has already been made in the columns of *Science*. These are designed to answer a double purpose, — first, to give a general representation of the prevailing winds for every month, based on the materials from which the more detailed meteorological charts above described are constructed; and, second, to serve as a ready means of publishing the

PILOT CHART OF THE NORTH ATLANTIC OCEAN.

MAY, 1884.



U.S. Hydrographic Office, Bureau of Navigation, Navy Department. Washington, D.C.

information concerning wrecks, ice, etc., gained during the preceding month. Through the kindness of Commander Bartlett, we are enabled to present a copy of the chart for May, reduced to two-fifths of the original, from a special print in black. As stated in the legend, every thing concerning the current month (in this case, May) is printed in blue in the regular issue; thus the direction and force of the winds are given, with the probable limits of the trades and of floating ice. On the May chart, the sailing-route to the equator, and the safe route to England, are added. On the other hand, information received concerning floating wrecks, ice, and notable storms or fogs, is printed in red. Only the geographic outline, the currents, and the permanent wording, appear in black on the original charts. The first four numbers, December to March, were accompanied by a few pages of letter-press, giving information concerning wrecks, storms, etc.; but it has later been found possible to present sufficient detail on the chart itself. Although the publication of these charts was duly authorized, no special appropriation was made for the collection of the information that they are designed to show. The co-operation of seafaring men, and those interested in the weather of the ocean, is therefore solicited. The distribution of the charts from the branches of the hydrographic office lately established in New York, Philadelphia, Baltimore, and Boston, as well as from the central office in Washington, will, doubtless, prove a strong incentive to a more complete reporting of the desired observation.

Having thus considered what has been already accomplished for the North Atlantic, we may give a few lines to studies now in progress in different parts of the world. Germany, England, and Holland have entered into a kind of co-operative agreement by which each party is to take charge of a relatively small part of certain oceans, and examine all the observations, furnished from all the parties, with the utmost detail; this plan being the outcome of several meteorological congresses. So far as I can learn, the German government, through Dr. Neumayer of the Deutsche seewarte at Hamburg, is at work on the North Atlantic between latitudes 20° and 50°, from shore to shore, the results to be tabulated in one-degree squares. About one-eighth of this work has been published.[1] The British meteorological council, of which Gen. R. Strachey is chairman, and Mr. R. H. Scott, secretary, has about completed a series of sea-surface temperature charts of the three great oceans for the cardinal months, February, May, August, and November, and have on hand a similar set of barometrical charts. A more original undertaking is the preparation of daily synoptic charts of the North Atlantic, in charge of Capt. H. Toynbee, for the thirteen months beginning Aug. 1, 1882, and ending Aug. 31, 1883; this being the period covered by the international circumpolar observations. It is estimated that there will be at least four hundred observations for each day; and from these it may at last be discovered what becomes of our Atlantic gales. The Indian meteorological service, in charge of Mr. H. F. Blanford, is studying the Indian Ocean north of the equator, lapping to the eastward over the area taken by the Dutch. The Dutch government, represented by Dr. Buys-Ballot of the Meteorological institute at Utrecht, has undertaken the investigation of the China seas (0°–30° north latitude, 100°–150° east longitude), but the results have not yet appeared. The former work of this office on the surface temperatures of the Atlantic, although of much importance, has, perforce, been omitted in this review; nor has there been space to consider various essays on ocean surface temperatures by Petermann, Cornelissen, and Koldeway, which might well be compared with the results on our hydrographic charts. The winds furnish material enough for examination in one essay.

It is surely fitting that our government should bear its share in these invaluable studies, and we trust the work now approaching completion for the North Atlantic may be speedily followed by similar studies of the rich material in our possession from the other oceans. W. M. DAVIS.

[1] *Deutsche seewarte. Resultate meteorologische beobachtungen von deutschen und holländischen schiffen für eingradfelder des nordatlantischen Oceans.* (*Quadraten* 146 *und* 147.) Hamburg, 1880, 1881. These include the area between 40° and 50° north latitude, and 10° to 30° west longitude.

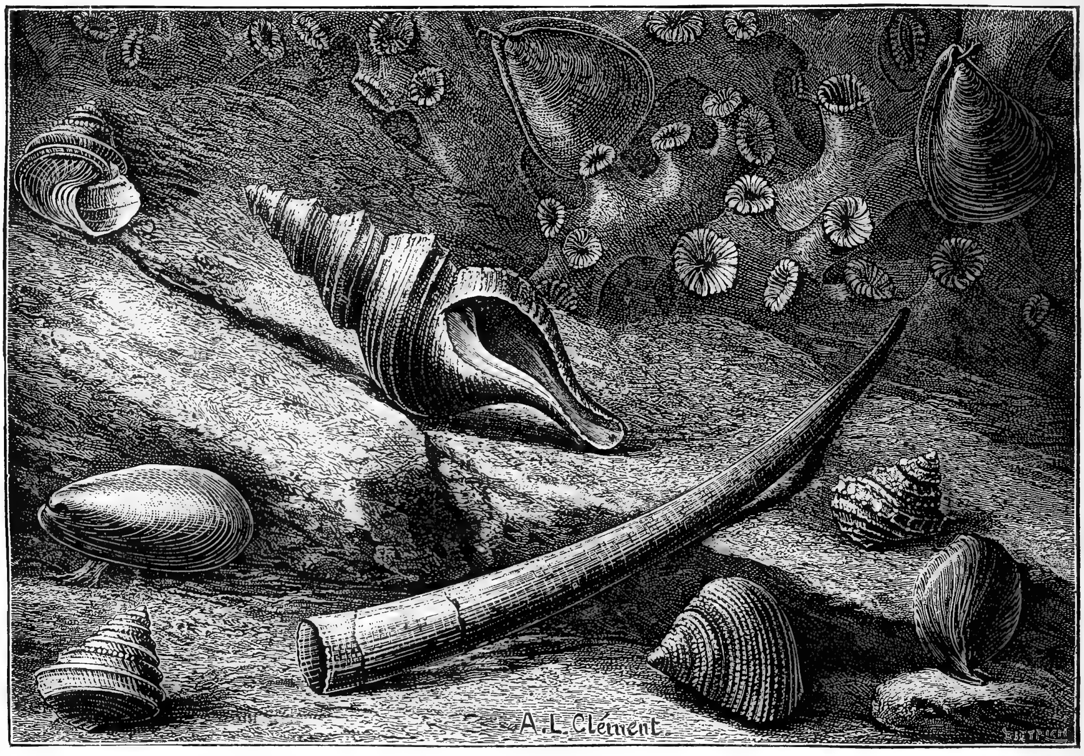
INVERTEBRATES OF THE TALISMAN EXPEDITION.

IN a communication to the French academy, Dr. Paul Fischer observes, that, during the voyage, attention was directed especially to determining whether the deep-sea fauna of the tropical seas is peculiar to the geographical region, or derived by emigration from arctic seas. By dredging in a north and south direction in the eastern Atlantic, and comparing the results from different latitudes with those obtained by others in northern seas, it was hoped to arrive at a satisfactory solution of the problem. The line upon which work was done extended from the mouth of the Charente, over thirty degrees of latitude, to Senegal.

It is known that the superficial and abyssal faunae of the seas of tropical Africa differ greatly. The genera are not the same: their respective assemblages have no parallel relations. If the remains of these two contemporaneous faunae were fossilized, it might be supposed that they belonged to two different epochs, or represented the population of two uncommunicating seas. The abyssal fauna of the coasts of the Sahara, Senegal, and islands of Cape de Verde, contains a number of mollusks common to the arctic seas which have an immensely wide distribution. Such are Troschelia berniciensis, Chrysodomus islandicus, Scaphander puncto-striatus, Lima excavata, Malletia obtusa, Limopsis minuta, Syndosmya longicallis, Neaera arctica, N. cuspidata, Pecten vitreus, and P. septemradiatus. These range from Iceland and Finmark, or northern European seas, in comparatively shallow water, southward to various

points on the line, terminating at Senegal. A blind Fusus was dredged in over twenty-five hundred fathoms. These instances are sufficient to show the extension of arctic forms into tropical regions, but with these are found a great number of mollusks yet unknown in the North Atlantic. The abyssal fauna of the African coasts is therefore not composed solely of arctic immigrants. Lovén has shown that the arctic species range at greater depths as they advance southward, — a fact confirmed by other naturalists, and by the researches of the Talisman party. It is probable, therefore, that the idea now generally entertained by malacologists is correct, that the range of these animals is determined by temperature rather than by the intensity of light or other factors. The investigations of the Talisman have considerably enlarged the number of Atlantic stations for mollusks reputed peculiar to the Mediterranean. Among these are Cassidaria tyrrhena, Umbrella mediterranea, Xenophora mediterranea, Carinaria mediterranea, Pyramidella minuscula, Pecten pes-felis, Spondylus Gussoni, and a number of others. Dr. Fischer concludes that the Mediterranean has very few peculiar species, and appears to have been populated in great part by colonists from the Atlantic, after the geological period in which communication with the Indian Ocean was cut off.

Lastly, the expedition obtained some of the remarkable forms first signalized by the U. S. fish-commission from deep water in the North Atlantic, among which may be mentioned Pholadomya arata, Mytilimeria flexuosa, etc. W. H. DALL.



DEEP-SEA MOLLUSKS LIVING AT A DEPTH OF FROM 1,500 TO 2,500 METRES. (Taken from *La Nature*.) Calliostoma, Modiola, Fusus, Dentalium, Turbo, and Terebratula are represented.

THE RELATION OF THE MOUND-BUILDERS TO THE HISTORIC INDIANS.

IN *Kosmos*, vol. xiv., parts ii. and iii., will be found two papers, by Dr. Emil Schmidt, on the relation of the mound-builders to the modern Indians. The reputation of the author as a student of American aboriginal history will give to these papers great weight in Germany. It is important, therefore, in the interests of true science, to know what they contain, to indorse them where they are in harmony with the latest investigations, and to correct any mistakes into which the author may have fallen.

After paying a just compliment to the Peabody museum, the Smithsonian institution, and the Bureau of ethnology, and expressing his regret that the laity are still disposed to behold something wonderful and mystical in every thing that the mounds reveal, Dr. Schmidt passes in review the history of mound exploration for the last century. Capt. Hearne, in 1791, expressed the opinion that the earth-works could not have been the production of hunting Indians,

but of a sedentary people, under fixed laws and organized society.

Bishop Madison, in 1803, applied first to the works the titles 'sacred enclosures,' 'temple-mounds,' 'sacrificial mounds,' etc. Few of the successors of this writer — Atwater, Squier, Baldwin, etc. — have done any thing to lift the veil of mystery which encompasses the subject. Prehistoric America stands opposed, in their view, to the historic Indians: a cataclysm cut off the mound-builders, and the modern aborigines are a new revelation on our soil. In anatomy and culture they stood apart. They formed dense settlements in the Mississippi valley, organized despotic governments, worshipped the sun in holy places or on temple-mounds, and offered human sacrifices on their altars. They practised agriculture, handicrafts, and art extensively, amused themselves in well-ordered plazas, and buried their dead in mounds. Their time reached thousands of years back; their origin is unknown; they were driven from their homes by savages many centuries before Columbus. If any thing remains of their influence, it is to be sought in Mexico and Central America.

However unscientific much of the investigation has been, we have still material for the classification and comparative study of the mounds and earth-works. That the 'works' were designed for defence alone, Dr. Schmidt thinks there is no doubt; but they certainly tell us very little concerning the social organization of those who dwelt within them.

The author, speaking of the animal mounds, says they are usually of no specialized form, the particular animal typified in any case being unknown. There is nothing improbable in the suggestion that they are connected with the totemic system of all American aborigines. The truncated mounds, correlated by the older archeologists with the Mexican teocallis, were undoubtedly the sites of dwellings, acquiring their great dimensions in many instances by years of accretion.

The altar-mounds prove merely that here corpses were burnt, and with their ashes were deposited the things of greatest value to the dead. Surely there is nothing unique in this, since barbarous nations have done the same thing in all places and times. Let us, therefore, draw the pen through all the fables that have been written upon the civil and religious institutions of the mound-builders. Of the sepulchral mounds, Dr. Schmidt tells us that their variety and structure can be observed in the old world as well as in the new; and as for the fortification and signal mounds, they are generally only mounds of sepulture.

The geographical distribution of the various types points, not to one race, but to a variety of ethnic groups.

With respect to the art of the mound-builders, weaving, pottery, agriculture, metal-working, commerce, and war, there occurs nothing to differentiate them from the modern Indians. The attempts to connect them with Greeks, Etruscans, Phoenicians, or Hittites, through the 'inscribed tablets,' are not worthy of serious criticism. When we turn to the remains of the people themselves, the varied utterances of those who have studied the matter are a sufficient commentary upon their results. Indeed, the crania are so distorted that no conclusions can be reached; nor are the discussions upon the antiquity of the mounds of any greater value.

Dr. Schmidt's second paper is devoted to an examination of authorities to show, that, in each respect wherein the mound-builders have been deemed a unique people, modern or historic Indians have been found to equal or excel them. The author discusses systematically, for this purpose, agriculture, fortifications, buildings on the upper terraces, house-building, effigy-mounds, platform-mounds, deposits with the dead, cremation, stone-working, pottery, metal-working, ornamentation, textile fabrics, etc.

So much for the possibilities of the case. That the mound-builders were the immediate ancestors of any of our historic tribes must rest on language and tradition. In the Iroquois and Algonquin traditions, the author finds the necessary information concerning the commencement of that disaster which swept away the mound-builders, and, in the traditions of the Cherokees and Muskoki, the narrative of their extinction. We know their name, Allegéwi; in part, their language; we know their conflicts, and their last century of defeat and decline. The linguistic argument is based on the discussion of Indian migrations as evidenced by language, by Horatio Hale.

With the author's arguments, from traditional and linguistic grounds, for the identification of the mound-builders with the Allegéwi, many will have little sympathy. It is to the first part of the essay that especial attention is directed. On general principles, the continuities of human historic evolution are everywhere becoming even more apparent than those of the natural world. It is difficult to believe, therefore, that the erectors of the earth-remains of the Mississippi valley were a discrete people. The arguments of Dr. Schmidt are strengthened by the recent explorations and researches of Professor Cyrus Thomas in the mounds; of Mr. W. L. Holmes in the shell-carvings and textile work of their builders; and of Mr. H. W. Henshaw, the ornithologist, in the identification of the animals of the mound-pipes, etc. "It is certain," says Mr. Henshaw, "that, of the carvings from the mounds which can be identified, there are no representations of birds or animals not indigenous to the Mississippi valley. A large majority of the carvings are not exact likenesses either of animals or men. The state of art-culture has been greatly over-estimated." It is of the utmost importance to bear in mind, however, the fact, well authenticated, that the arts, complexity of social structure, and knowledge, of our modern Indians, have been greatly underrated. The probabilities of consanguinity between them and the mound-builders will be enhanced as well by placing the culture of the former on its true basis, as by an unjust depreciation of the works of the latter. O. T. Mason.

ENCKE'S COMET, AND THE RESISTING MEDIUM.

It is well known to those interested in the subject, that one of the very few cases in which the celestial motions are not perfectly represented by the law of gravitation is afforded by Encke's comet. Half a century has now elapsed since Encke announced that the comet, at each return, reached its perihelion two or three hours sooner than was expected. This lessening of the period was continually repeated at every return, thus showing the action of some continuous cause. He proposed the hypothesis of a resisting medium, or atmosphere, surrounding the sun, as affording the most plausible explanation of the fact. Encke having died in 1865, the subject was next taken up at the Pulkowa observatory by von Asten. The latter died in 1878; and, after some delay, the work was continued by Dr. O. Backlund, a young Swedish astronomer of brilliant reputation. His second memoir on the subject has just been published, and includes a minute discussion of the observations from 1871 to 1881, as well as a revision of some of Asten's work. The most important result which he reaches is, that the acceleration is still going on, but is only half as great as that found by Encke. One of the anomalous results reached by von Asten was, that during the two revolutions from 1865 to 1871 there was no acceleration. The revision of his work by Backlund shows, however, that this result was due to an error in some of the formulae which he used, and that, when this error is corrected, the effect is found to be continuous.

No new light has been thrown on the cause of this result. Astronomers have not generally considered the acceleration as a well-established fact; because the accurate computation of the perturbations produced by the planets, especially by Jupiter, is so intricate as to be very liable to small errors. The fact that Backlund has found an acceleration only half as great as that of Encke, shows that the method of the latter may be subject to doubt. At the same time, the amount of mathematical research which has been applied, and the constancy of the results found by all three investigators, now seem to leave little doubt of the fact. One reason for doubt has been that no other comet exhibited this retardation. This has been especially shown to be true of Faye's comet. But the difference in the two results may be fully explained by supposing that the atmosphere which resisted Encke's comet does not extend far beyond the orbit of Mercury, the fact being that Faye's comet does not even come within the earth's distance from the sun. There is no other comet on which the hypothesis can be tested.

The possibility that there is an exceedingly rare atmosphere around the sun is well worthy the attention of astronomers and physicists. The zodiacal light, the motion of the perihelion of Mercury, and the acceleration of Encke's comet, all point in this direction. The strongest evidence is afforded by the zodiacal light, because this shows that matter of some sort exists within the region referred to. But hitherto no means have been found to decide whether this matter is in a gaseous form, or in that of minute particles. In the latter case, the total mass would be too small to produce any effect upon the motion of either a planet or a comet. In the former case, however, we cannot assign any such limit. Researches into this subject under favorable conditions are greatly to be desired, especially observations upon the zodiacal light at some elevated point near the equator. As science becomes more extended, it is to be hoped that stations for observations will be selected with less regard to local considerations, and with more regard to the conditions of scientific success.

THOUAR AND CREVAUX.

The final report of Thouar, on his search for survivors of the Crevaux party, has been made public, and terminates the record of that gallant but unfortunately fruitless expedition to which reference has several times been made in these columns. By fruitless it is not intended to convey the idea that valuable results for geography and ethnology have not been attained by Thouar, but merely that the forlorn hope of rescuing alive any of Crevaux's party was disappointed.

After traversing with great haste the high plateau of Bolivia between La Paz and Oruro, experiencing a temperature of zero, Sucre, Tarija, and Caïza were successively reached. Conferences were had with all who seemed likely to afford information or advice; and letters written in French, Spanish, and the native dialect, were sent out among adjacent tribes. But even at this time there were no survivors. All that he could rescue was a broken barometer; a letter of Crevaux; a sketch-map of the Pilcomayo, prepared by Crevaux, and annotated by Billet; and a piece of one of the boats. On the 11th of September, 1883, he reached the spot where the massacre took place, where a photograph was taken, and two wooden crosses erected in memory of the victims.

The dead were cut in pieces by the Tobas, and each chief carried to his camp one of these ghastly trophies. The attack was prompted solely by a desire for vengeance. When Thouar inquired why they had killed Crevaux, who was so kindly disposed toward them, they invariably replied, "We killed your brother because those of your color have killed ours." The dead were dismembered on the very spot where, a few days before, several Tobas had been shot by some inhabitants of Caïza. Thouar hardly finds it in his heart to blame the Tobas, who had been wantonly assailed, and who know no distinction between white men. "The Toba," he says, "is strong, muscular, above the middle height. He has a dignified and impressive carriage. His color is that of old mahogany; his face is framed in long hair, black and straight; his forehead is narrow; the eyes slightly oblique; his cheeks prominent; his nose thick, broad, flattened at the tip; his mouth large. He occupies himself exclusively in fishing and hunting. His face, breast, and arms are ele-

gantly tattooed with charcoal made from cornstalks. In his ears are large cylinders of wood. He is rather idle, and does not cultivate the ground. His hands are so soft, that, if required to use an axe, he will blister them. The female Toba is strong, and of an agreeable aspect. Both are clothed in *ponchos*, with a breech-clout and sheepskin for warmth. They are much given to drinking a fermented liquor made from native grain, which is, however, denied to the women; and in each encampment there is always one Toba who does not drink, and whose business it is to preserve order and make up quarrels. They have several games with balls, etc., which they play for prizes, such as a sheep or horse. The women are very jealous of one another, and fight bitterly among themselves on the slightest occasion. Armed with sharp fish-bones, the combats, which the males regard with indifference, often end fatally. They believe in a good and in an evil spirit, and in ghosts of the dead."

Thouar had two hundred men put at his disposition by the Bolivian government, and with these undertook to traverse the Grand Chaco, and follow the course of the Pilcomayo. More than once he was obliged to give battle to hostile natives of various tribes, and, but for his Remington guns, might have been routed. The party was also annoyed by numerous jaguars, which prowled about the camp, and frequently stampeded the horses. The river is reported at that season to be fifty metres wide, but flowing between banks eighteen hundred metres apart, and twelve or fifteen metres high. The trees were like acacias, of delicate foliage, growing twenty or thirty feet high. On either side stretch immense plains covered with rich pasturage. Numerous large lakes were observed. On the 10th of November, pale, hungry, worn with fatigue, their clothing in rags, the party reached the Rio Paraguay and civilization.

The gallant explorer has been crowned by the academy, and has received the gold medal of the Société de géographie. It is probable that he will be enrolled in the Legion of honor, as a distinction fairly won.

W. H. D.

COUES'S BIOGEN.

Biogen: a speculation on the origin and nature of life. By ELLIOTT COUES. 2d ed. Boston, *Estes & Lauriat*, 1884. 66 p. 12°.

THIS little book contains a lecture on something to which the author gives the name that stands first on his titlepage. But the principal doctrine of the book, apart from the new thoughts to be suggested in its support by the author, needs no new name; being, as Professor Coues himself insists, nothing but the ancient doctrine that there is an immaterial basis for mental life, and that physical life itself is maintained by a peculiar 'force.' The author has previously privately printed his lecture, which was delivered to the Philosophical society at Washington; but the present edition is the first one actually published. In it the author adds a preface and an appendix. The discussion has plainly grown on his hands; and he expects to follow up this publication with other essays, since he now feels himself "in position to express himself more fully, freely, and explicitly on the subject" than he could do at first.

Not all of our author's readers will find it easy to take him very seriously, and for the benefit of such he has given in his preface a very entertaining collection of amusing things that have been said to him about the lecture since its delivery. Yet, if the little book will be diverting enough to many people, it is not to be regarded as merely a diversion: for Professor Coues has certainly enriched the ancient controversy with several new words, and with several misuses of old words; and the serious critic must accordingly look carefully to see whether this is all, and whether, in fact, philosophy has come out from under our author's pugnacious treatment with any addition save a swollen vocabulary.

It is in the appendix that Professor Coues undertakes to define the terms that are to be used in discussions about the nature of the soul of man. His definitions are of this sort: "A man's 'mind,'" he begins, "is not a *thing* in the ordinary sense of the word 'thing:' it is a relation between two things. These two things are his soul and his body."

But what, then, we ask, is the soul? "The soul," we learn, is a thing, "an actual entity, a living being of knowable and recognizable qualities, attributes, and potencies." "It consists of a kind of semi-material substance." This substance is "animalized astral fluid; that is to say, some quantity of the universal ether, modified by vital force." To this 'soul-stuff' the name 'biogen' is applied. It corresponds closely to the recently famous 'fourth state of matter.' It is the 'od' of Professor Reichenbach. It exists in all animals and plants while they live. This stuff helps the spirit to act upon matter. As for spirit, it is the immaterial element in the world. Soul and spirit are, therefore, not the same thing. Soul is 'semi-material:' spirit is not material at all. Spirit cannot act directly on matter: soul is the body of the spirit, and helps it to act on grosser matter. This semi-material soul persists after death, and is then all of a man that remains, besides his immortal spirit. Under earthly conditions, the gross material body is added, and interaction between this body and the spirit is made possible by the presence of the semi-material soul. The soul-

substance, or biogen, is the vital principle of the living man. Thus far, then, our author.

We are in no wise concerned, as yet, to test the truth of all this. We desire, for the first, only to examine the good sense of it. Our author suggests several interesting thoughts by his very original definitions. Mind is only a relation between soul and body, but not a thing. 'Mind,' also, 'is what the spirit thinks in consequence of its connection with matter.' 'Reason is the mistress of the mind.' 'Its exercise is judgment, or the critical faculty.' Hence, it seems, Professor Coues would define a judgment as "the exercise of the mistress of a relation that the spirit thinks, in consequence of its (the spirit's) connection with matter." This definition obviously expresses a very distinct advance in the clearness of philosophic thought, and ought to be useful in future logic text-books. The materials for it are found on one page together. However, it is somewhat unfair to judge Professor Coues by any one page of his book, since he says various things on various pages; such as, that "mind [viz., the aforesaid 'relation'] is what the spirit retains when it becomes disembodied" (p. 61), and that "mind, as the expression of a relation between the soul and the body, necessarily disappears when that relation is discontinued" (p. 13). It follows from all this, that Professor Coues has been led to enrich philosophic language by a definition of mind of which he himself can make nothing, and of which we, of course, cannot hope to make much more.

But of mind, enough. Let us think of this *soul-stuff*. It is 'semi-material.' This may mean either of two things: it may mean that soul is made, half of it out of matter, and half of it out of something else; or that the soul is a sort of a something that is neither matter nor the opposite of matter, but halfway between the two. Which is our author's meaning? If we go from the appendix to the lecture, we find (p. 55) a definition of biogen, or soul-stuff, as "spirit in combination with the minimum of matter necessary to its manifestation." This would seem to answer our question. Biogen, or soul-stuff, is semi-material because it is spirit plus a minimum of matter. The same view is borne out by expressions in the appendix itself. But other expressions give countenance to the other view. The soul-stuff is the 'body of the spirit.' Its substance is the 'medium of communication between spirit and matter.' It is tenuous, elastic, and probably not atomic in structure. It flows about, it is sometimes projected from the living body during sleep, etc. In all these cases the *semi* in *semi-material* seems to refer, not to the composition of biogen as being matter plus spirit, but to its nature as being halfway between matter and spirit. Soul-stuff is thus expressly opposed both to spirit and to gross matter, being a sort of a something in between the two. One infers, from this confusion and self-contradiction, that Professor Coues has written his essay on biogen without ever knowing what he really means by the word, although it is all his own.

The relation of this biogen to 'vital force' is also a question which a careful reader anxiously considers. Biogen is not a force at all (p. 64), but a THING (the capitals are our author's). When acted upon by spirit, however, it is the 'vital principle;' and the 'vital principle,' as we learn from p. 63, is "simply the force by which the spirit acts upon matter through the medium of the soul." Hence, to sum it all up again, the soul-stuff, which is not a force, but a thing, becomes, nevertheless, when acted upon by the spirit, a force; viz., that force by which the spirit acts upon matter through the medium of this soul-stuff itself. This we must leave to the reader's ingenuity to unravel. We confess ourselves baffled.

Clear ideas about biogen the reader must therefore not expect. Professor Coues does not go to his philosophic studies for such cheap commodities, and nobody need demand such things from him in this field. He has simply amused himself a little by telling us about the well-known traditional views of many people, using a hopelessly muddled terminology of his own invention to express no more of the traditional view itself than many well-instructed children in religious schools can tell us. And they would understand their language quite as clearly as Professor Coues seems to understand his own. No apology, to be sure, would be needed, if Professor Coues had simply come forward to maintain in a plain manner so ancient and respectable a faith as that in the existence of immaterial forces and agents: but there is, at the same time, no reason why he should confuse our minds with new meanings, that are yet no meanings, given to words that we have long since learned to use somehow; and there is no need of new words, unless the inventor can give us some clear idea of what they are to mean. Therefore the value of our author's contribution to the discussion becomes forthwith obvious.

The lecture itself is devoted to proving the dogmas thus defined. But it is enough to say of the whole argument therein set forth, that our author seems entirely to forget one very

simple question which nowadays the plain man puts whenever he hears of such a discussion as this. The objection to 'vital force' and 'immaterial agents' in the plain man's mind is, that they are like the 'dormitive virtue' of opium. They are just x and y, used where all hypotheses of a more definite nature just now fail to do the required work; and they simply say that some conditions not now better known must be present to cause certain phenomena, such as those of life, or such as the phenomena of the human mind. They differ from x and y only in being less frank expressions of ignorance. They masquerade (so thinks our plain man) in the long-clothes of Latin or Greek terms; but they are none the better for that, and we are none the wiser. Now, Professor Coues altogether neglects, in his discussion, to set the plain man's mind at rest about this matter, so far as this objection would apply to his biogen. Apart from the wildest assumptions concerning the 'ether' or the 'astral fluid,' Professor Coues has nothing to say in favor of biogen, save that nobody can make living matter, and that nobody can explain the origin of our minds. Hence, he reasons, the soul is immortal, and biogen is a fact.

All this is of course tedious. We have long since abandoned such methods. Materialism, as a philosophic theory, is indeed untenable enough, and no intelligent student of philosophy in our day is apt to become an old-fashioned dogmatic materialist; but heaven knows, that, if such arguments as this of our author were our only refuge from materialism, we should all forthwith be either materialists or word-mongers.

Such thinkers as Professor Coues lets himself be joined with in this lecture, have no genuine conception of what a philosophic problem is. To them materialism is a doctrine to be combated by talking about the mysterious character of life, and the possibility of 'semi-material' substances. They do not see, that if the spiritual character of the world, and the supremacy of reason in it, are to be proved at all, they must be so proved as to make reason actually manifest in all parts of the world. If an atom or a brick-bat, however incomplete an expression of reason it may be, is not as truly an embodiment of the rational and spiritual reality that lies at the foundation of things as is the best-organized structure on the planet, then there is no truth at all in a spiritual theory of the world. Therefore let nobody fancy that he proves or disproves the world to be rational or spiritual by proving or disproving that there are one or two subtle fluids in it more or less than had been noticed before. If life result from an altogether unique natural 'force,' so be it. Prove and make plain the meaning of the fact, and we shall be as content with it as with any other natural truth. But that proof would not make life one atom more or less spiritually significant than it now is. The moral and the rational order of the universe would be in no wise more or less manifest; the fallacy of philosophic materialism would be no more or less evident; and, if we could make shiploads of Shakspeares in our laboratories to-day, the spiritual nature of things would be no less certain. Discussions that dwell with rapture on possible, vaguely defined, mysterious, 'semi-material' fluids and potencies, help us no nearer to the explanation or to the proof of the rational truth of things, and do help us to think less rationally ourselves.

There are, in fact, two forms of idealism prevalent amongst us. One we might call the mendicant form of idealism; since it is always begging the world of experience to show us something fantastic, romantic, intangible, unutterable, so that we may live in awe as at a juggler's show. To this view God is himself a sort of showman, who likes to hear our outbursts of wonder when he does odd things. Such idealists are never so sure of the spiritual truth of things as when somebody has just finished a ghost-story. Or, if they abandon this fashion of idealism, they devote themselves to inventing halfway substances, too fine to be seen or touched, too subtle to be reached by physical experiments of any sort, far less the objects of experience than is the universal ether an object of experience, and unlike the ether in having no definable properties. These they glory in. These are the earnest to them that our world is not commonplace nor gross, but the offspring of reason, the dwelling-place of God's power.

To such idealism Professor Coues seems willing to join himself. His idealism, it would seem, would be in some danger if we found how to produce live germs in our laboratories. He hints at mysterious stories of a supernatural character as indicating something about the nature of biogen. He seems to depend on the phenomena that are not yet explained, as the sole foundation for a spiritual theory of the world; and he seems, meanwhile, to suppose himself a kind of Elijah among those worshippers of Baal, the materialists. Only believers in the fantastic and indefinable can be idealists; and he is one of the few faithful.

But there is another form of idealism in the

world, and that idealism is indifferent to all this love of merely fantastic and romantic mystery. It regards the world as through and through rational, and for that very reason it does not suppose phenomena to be more divine, merely because of the accident that we cannot explain them by any general rules of experience. It insists, that if we could produce new life of any order, high or low, as easily as we can strike a light, life would be no more and no less a manifestation of the divine reason than it now is. And this idealism needs no subtle 'astral fluids' to convince it that there are spiritual realities. The true nature of a cow is not more manifest in skimmed and watered milk than it is in the rich new milk; and this trust in 'subtle media' is merely a demand that we shall believe only the skimmed milk of nature to be a genuine expression of the divine life. If all the matter in nature were for our senses composed of indivisible particles as big as paving-stones, and if every heap of these paving-stones, however and whenever made, behaved just like a rational being, and wrote philosophic lectures, the spiritual nature of reality would be just as manifest as it now is, and philosophic materialism would be just as absurd. Hence Professor Coues does what this second form of idealism regards as something worse than wasted labor. He not only talks confusedly about his unintelligible biogen, but he helps to disseminate the impression that a belief in a spiritual truth in the world depends upon a faith in the existence of some fluid so thin that you cannot say any thing definite about it. All this is rank paganism; for it is analogous to the views of those peoples whose gods are conceived after the fashion of smoke.

JOSIAH ROYCE.

REPORT OF THE OBSERVATORY AT HERÉNY, HUNGARY.

Publikationen des astrophysikalischen observatoriums zu Herény in Ungarn. Herausgegeben von EUGEN VON GOTHARD. Heft i. Herény, 1884. 104 p., 6 pl. 4°.

THE astro-physical observatory of Herény has recently issued its first volume of publications, prefaced by the director, von Gothard, with a graceful tribute to his friend, the well-known Dr. von Konkoly.

The observatory is situated on the estate of Herény, near Steinamanger, in the western part of Hungary. The main building was finished in 1881, and is of two stories, with a tower for the equatorial at one corner: a smaller building receives the transit instrument. The rooms are all admirably planned and arranged to promote the comfort and efficiency of the observers. In the upper story we find an office, a room for the director, and a large, well-appointed physical laboratory. On the ground-floor there are, besides two smaller rooms, a chemical laboratory fitted with many conveniences, and a workshop. The workshop, a feature in which most of our observatories are deficient, is supplied with tools intended not only for making minor repairs, but for constructing many valuable pieces of apparatus; and what is even more valuable, as it is unusual, the director and his assistants appear to be skilful mechanics.

The principal instrument of the observatory is a Newtonian reflector by Browning, of ten and one-fourth inches aperture, which is provided with a very complete outfit of photographic and spectroscopic accessories. A little portable transit of about an inch aperture, the object-glass of which is by Fraunhofer, and the mounting by Reichenbach, is used for determining time. There are two astronomical clocks by Freitag, a set of meteorological instruments, and a large collection of subsidiary physical apparatus. The library, though still small, is steadily increasing.

The director of the observatory, Eugen von Gothard, is assisted by his brothers, Alexander and Stefan von Gothard, and by Josef Molnar. The observations in the present volume are, for the most part, upon the spectra of the fixed stars. In 1881 and 1882 the spectra and colors of nearly three hundred fixed stars were examined, and the stars classified according to Vogel's types. Spectroscopic observations, and observations of a generally descriptive nature, were also made of Wells's comet, the great comet of 1882, and Barnard's comet. This, together with observations for time, and the care of the clocks, has been the director's work. Alexander von Gothard contributes the physical observations upon Jupiter and Mars, accompanied by twenty-four well-executed sketches. Miscellaneous observations include observations of the solar eclipse of May 16, 1882, and the August meteors of that year. Satisfactory observations of the transit of Venus were not obtained on account of unfavorable weather.

In the typography of the volume, and in the care and neatness with which the plates are prepared and bound, the young observatory will compare favorably with many older institutions.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Work in California. — During March, rainy weather interfered very much with the field-work in the division of the Pacific. The study of the Knoxville region, however, was completed by Mr. Becker, who made two cross-sections of the area mapped, and finished his notes of the surface-geology.

Four sections were made of the Redington quicksilver-mine, and notes of others also taken. The first half of April was very stormy, rendering a camping-trip inexpedient. On the 1st of the month, however, Mr. Turner proceeded to Tres Pinos, to make observations on the granite reported to be in that neighborhood by Antisell and others. Between the first and the middle of the month, Mr. Turner occupied the intervals between the storms in making a reconnoissance of the region adjacent to Tres Pinos.

About the middle of April, Mr. Becker and a party, including Mr. Turner, proceeded from Tres Pinos to New Idria, making excursions on both sides of their route, and reaching New Idria the latter part of the month. Mr. Becker hopes to complete the New Idria district during May. He reports that the granite between San Francisco and New Idria, of which there is a considerable amount, is, so far as he has seen it, of one character, and does not differ from that of which the Farallone Islands are composed. It presents lithologically no evidence of recent origin, but has all the appearance of ancient granite. He reports, also, the existence of large areas of basalt at no great distance from Tres Pinos, and an important area of the same rock immediately south-west of Panoche valley. He says, also, that the most cursory study of the pebbles of the recent stream-beds, and the extensive gravel-deposits of the area passed through, renders it evident that there are other important areas of basalt. The same sources of information also prove that andesite eruptions must have taken place abundantly, although in his hasty trips he did not come across the rock *in situ*. He thinks that a thorough examination of the coast-ranges north of New Idria would show a considerable area of andesite. The sedimentary deposits noted were of three classes: 1°, highly metamorphosed and sometimes contorted beds, similar to those of the Clear Lake and Knoxville districts; 2°, lying unconformably upon the latter, considerably tilted, very slightly contorted, unaltered beds, mainly sandstones, exceedingly fossiliferous in places, and corresponding to Whitney's miocene; 3°, resting unconformably on these, again, uncompacted conglomerates, very slightly tilted, and, so far as examined, without fossils.

In the laboratory at San Francisco, Dr. Melville has been engaged in routine analyses.

Mr. Curtis has been in Washington for some time, revising proof of his monograph (No. 7) on the silver-bearing lead-deposits of Eureka, Nev., which is in press.

Mr. Hoffmann finished the corrections and additions to the topographic work at Clear Lake in April, and early in May reported at Washington, where he will map the work done by him in 1882 in northern California.

Miscellaneous. — Nearly all the rocks collected by Mr. J. S. Diller in the Cascade Range, in northern California, have now been identified; and the labelling and cataloguing of the collection, so far as thin sections of the rocks have been prepared, have been completed. The hypersthene andesites are found to be the most abundant. Members, also, of a new group of rocks have been found, which promise to be of especial interest. —— Mr. Vanhise, assistant to Prof. R. D. Irving, made, in March, seventy-two new thin sections of rocks; and descriptions were prepared of forty of that number. In April, Mr. Newman, at Washington, prepared eighty sections for Professor Irving, and also of a few rocks from the Cascade Range. —— Through the kindness of the superintendent of the Naval observatory, Capt. C. E. Dutton has begun a study of the moon's surface in connection with the study of the volcanic features on the earth. —— Mr. Diller has prepared about a dozen sections of fulgurite and its fusion-products, and is making a special study of them, with results of exceeding interest.

Engineers' school of application, Willets Point, N.Y.

Aurora borealis. — The regular series of records of the displays of the aurora borealis, begun in 1870, has been continued as heretofore. Three sentinel-posts, widely separated from each other, are guarded nightly by soldiers of the Battalion of engineers, specially selected as watchmen. Eight men are thus permanently detailed. Three of them remain on duty from sunset to sunrise, and are required to report, when relieved, whether they have seen any auroral light during the night, and, if not, whether the sky has been sufficiently clear to permit any to be visible. These records for the past year are presented in the following consolidated table, which,

AURORAL DISPLAYS IN 1883.

Name of month.	Auroras.				Clear nights.				Cloudy nights.			
	Post No. 1.	Post No. 2.	Post No. 3.	Mean.	Post No. 1.	Post No. 2.	Post No. 3.	Mean.	Post No. 1.	Post No. 2.	Post No. 3.	Mean.
January . . .	0	0	0	0.0	11	8	11	10.0	20	23	20	21.0
February . .	2	3	2	2.3	16	15	15	15.3	12	13	13	12.7
March . . .	4	4	2	3.3	22	23	21	22.0	9	8	10	9.0
April	3	3	2	2.7	16	15	15	15.3	14	15	15	14.7
May	0	0	1	0.3	17	16	17	16.7	14	15	14	14.3
June	1	1	1	1.0	16	17	18	17.0	14	13	12	13.0
July	5	6	5	5.3	22	22	21	21.7	9	9	10	9.3
August. . . .	1	1	2	1.3	26	26	27	26.3	5	5	4	4.7
September . .	4	3	3	3.3	15	16	17	16.0	15	14	13	14.0
October . . .	2	3	2	2.3	20	18	17	18.3	11	13	14	12.7
November . .	2	2	2	2.0	17	19	20	18.7	13	11	10	11.3
December . .	0	1	0	0.3	19	17	17	17.7	12	14	14	13.3
Total for year.	24	27	22	24.1	217	212	216	215.0	148	153	149	150.0

considering the difficulty of distinguishing the fainter displays, is regarded as establishing the trustworthy character of the record by the general accordance between the three independent observers. It appears, that, out of 215 favorable nights, 24 auroras were noted; and, if we may assume the same ratio to apply to the cloudy nights, about 41 auroral displays occurred during the twelve months.

These observations were undertaken to throw light upon the supposed connection between the number of solar spots and the frequency of auroras and of magnetic disturbances. They have now been continued long enough to give interest to the following summary, compiled from the annual astronomical orders. It will be noted that there is a marked correspondence between the epochs of maximum and minimum auroras, and of maximum and minimum solar spots, as given by Prof. Fritz of Zurich; viz., —

Epoch of maximum solar spots	1870.6
" minimum " "	1878.9
" maximum " "	1882.4

The column headed 'Average number of sun-spots' is derived from the observations of Prof. D. P. Todd, published by the U. S. signal-office.

SUMMARY OF AURORAL RECORDS FOR FOURTEEN YEARS.

Year.	Clear sky.		Cloudy sky.		Total for year.	Average No. of sun-spots.	Remarks.
	Nights.	Observed auroras.	Nights.	Probable auroras.			
1870	184	50	150	41	99	–	11 mos.
1871	211	60	154	44	104	–	
1872	234	60	132	34	94	–	
1873	214	54	151	38	92	–	
1874	190	18	175	17	35	–	
1875	189	14	176	13	27	–	
1876	195	9	171	8	17	–	
1877	191	7	174	6	13	2.6	Began
1878	185	2	180	2	4	2.2	June,
1879	204	9	161	7	16	2.0	1877.
1880	216	13	150	9	22	14.3	
1881	191	23	174	21	44	26.7	
1882	201	55	164	44	99	28.3	
1883	215	24	150	17	41	27.4	

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Albany institute.

May 13. — Dr. James Hall gave a description of some forms of newly discovered fossil sponges of the family of Dictyospongidae. Fossil sponges begin in the paleozoic rocks, and continue upwards through the coal-measures. The divisions of the fossil sponges are by fours : that is, some had four marked longitudinal lines or ridges; others, eight, and twelve, and sixteen. The most remarkable form was one with thirty-two radiating lines connected by concentric rings resembling a spider's web. Of this there are only two specimens in the world, yet discovered; and these are in the New-York state museum. Until within a few years the fossil sponges had been undetermined, and many had regarded them as the remains of true vegetable forms of life. Europe, up to 1883, had produced but five species of fossil sponges of the family Dictyospongidae. From New-York state, Professor Hall has secured thirty-five species, thirty-one of which he has been the first to discover and to describe. A notice of the family Dictyospongidae was read at the meeting of the American association for the advancement of science, in Montreal in 1882, and plates from the thirty-fifth Report of the New-York state museum of natural history were exhibited. The paper at present in press gives descriptions of the genera Cyathophycus, Dictyophyton (= Hydnoceras Conr. 1842), Ectenodictya, Lyriodictya, Thamnodictya, Phragmodictya, Cleodictya, Physospongia, and Uphantaenia, with numerous illustrations.

Academy of natural sciences, Philadelphia.

May 6. — Professor Joseph Leidy directed attention to some little tape-worms which had recently been submitted to his examination. They were expelled, after the use of santonin, from a child of three years. The specimens, consisting of a dozen fragments, appear to be portions of three worms, which probably reached a length of from twelve to fifteen inches. Unfortunately the head is lost. The joints, or proglottides, are several times broader than long. The eggs occupy a simple uterus, defined by the walls of the joints, and not divided into pouches diverging laterally from the main stem, as in most Taeniae. A singular feature of the worm is the interruption of the series of ripe joints, here and there, by one or more completely sterile ones. The generative apertures open in the usual way on the lateral margin of one side. The mature eggs are spherical, measure 0.072 of a millimetre diameter, and contain fully developed, six-hooked embryos. While differing greatly from the ordinary tape-worms infesting man, they approximate nearly the description of Taenia flavopunctata, and probably pertain to this species. This has been but once previously observed, and was described in 1858 by Dr. Weinland, from specimens in the museum of the Medical improvement society of Boston. These also were discharged by a child. It is probable that the worm is more common than would be supposed from the instances of its observation, and has perhaps escaped notice from its small size, and from the general ignorance of the distinction, not only of this, but of the ordinary species of tape-worms. —— Prof. J. T. Rothrock referred to the structure of the common violet, and remarked that he had observed that in the flower, the so-called path-finders, or lines of the petals leading to the ovaries, are much more conspicuous on the lower and side petals than on the others, thus rendering them of most use to insects, which are supposed to be guided by them to the ovaries.

May 13. — Professor Joseph Leidy exhibited specimens of a curious parasite (Pentastomum proboscideum), found in the lung of a large rattlesnake (Crotalus adamanteus) from Florida. They are cylindrical, incurved, annulated, largest at the head, tapering behind, becoming again larger, and rounded at the end, and terminating ventrally in a short, conical point. They vary from nine lines to thirty-one lines in length, and from one and a half to three lines in width at the head. Although these curious creatures, in their mature stage, are cylindrical, worm-like, limbless bodies, they are allied, by their structure and embryonic peculiarities, to the Arachnida, or spiders. —— Mr. Edward Potts announced the discovery in Harvey's Lake, near Wilkesbarre, of vast colonies of a species of the beautiful polyp, Cristatella. He had not been able to determine whether or not it belongs to one of the three described species of the genus. They may prove to be distinct, although it is not improbable that all the species may hereafter be considered as one. The specimens were collected from the smooth, inclined surface of logs, and from the branches and twigs of submerged trees. Colonies had since been formed on the sides of a collecting-jar, each statoblast having developed into from three to eight polyps. The colonies are not circular, but have a persistent appendage which contains none of the polypiferous cells. Supposing the form to be new, he proposed for it the name Cristatella lacustris.

Colorado scientific society.

May 5. — Messrs. W. F. Hillebrand and Richard Pearce made a preliminary communication in regard to an interesting group of minerals recently found in Utah, some of them being new to the United States. The minerals found are, enargite and the secondary hydrous arseniates, olivenite, and conichalcite (Dana's System of min., p. 565), with two amorphous substances corresponding, apparently, to pitticite and chenevixite. The olivenite occurs in small, distinct crystals; the conichalcite, in form similar to that from the only locality previously known, in Spain, while its chemical composition is also very near to that of the original mineral, a small amount of copper being replaced by zinc. Jarosite, turgite, and one or two as yet undetermined species, occur sparingly with the above. Mr. Pearce also exhibited pseudo-malachite associated with hübnerite from near Phillipsburg, in Montana.

Society of arts of the Massachusetts institute of technology.

April 24. — Prof. Charles R. Cross gave a lecture on 'The determination, history, and present standards of musical pitch.' After referring to the use of the sonometer for determining the relative number of vibrations of any two notes, Professor Cross gave a description of the methods of determining the absolute number of vibrations of any fork, giving an account of König's researches (*Amer. journ. otology*, October, 1880), and explaining the use of Scheibler's tonometer. The only good standard was stated to be the tuning-fork, which varies its rate less than $\frac{1}{9000}$ per degree (Centigrade) of change in temperature; while the organ-pipe and the oboe, sometimes used as standards, vary much more with changes of temperature. The history of pitch was discussed, and tables given showing the change in the standards from time to time. The principal change had been a gradual rise of the standard. Some measurements made by Professor Cross in 1880 had given results, of which the following is an abstract: —

	Number of vibrations, C_3.
Ritchie, copy of Chickering's standard	269
Mason & Hamlin, French pitch	259.1
Hook & Hastings, old flat organ-pitch	264.6
Organ in Church of Immaculate Conception, Boston	266.7
Chickering's standard fork	268.5
Smith American organ company	267.2
New-England organ company	268.2
H. F. Miller pianos	268.9
Hook & Hastings' standard	270
Weber pianos	270.3
Thomas's pitch, 1879	271.1
Music-Hall organ	271.2
Steinway's pitch	272.2
Highest New-York pitch	273.9

The standard used by the Boston symphony orchestra in 1882–83 was an A-fork of 448 double vibrations; that used in 1883–84 was a French A of 435 vibrations. The standard French pitch of the New-England conservatory of music is a middle C, a *true* sixth below the normal A, hence of 261 vibrations. Owing to the difference between the true and tempered sixths, the C-fork used with the orchestra which has A for its standard does not agree with this. Chickering and Miller have had C standard forks made which are a *tempered* sixth below the French A, making 258.7 vibrations, and which could therefore be used with the orchestra which has A for a standard. Thomas's present pitch is an A a little sharper than the French A. Comparing the highest New-York pitch given above with the standard in Handel's time, when the C-fork had 249.6 vibrations, the difficulty of singing some old music is readily understood.—— Mr. A. P. Browne explained the Deerfoot safety milk-can, by which the introduction of any adulterating substance into the can is rendered impossible, while the thorough mixing of the milk and cream is insured every time any milk is drawn out.

NOTES AND NEWS.

SEVERAL members of the New-York legislature, from the western part of the state, a year ago called the attention of their state board of health to the necessity of draining certain large, swampy, and miasmatic lands that lie in a shallow trough on the back of the hard Niagara limestone between Rochester and Niagara. In response to their memorial, Mr. Gardiner, director of the state survey, was requested by the board of health to make an accurate topographical map of the district, and to report upon a plan by which it could be drained; and accordingly sur-

veys were actively carried on last summer, with a result now presented in Mr. Gardiner's 'Report on the drainage of the Tonawanda and Oak-Orchard Swamps,' in the fourth annual report of the board of health, just issued. The two swamps are connected, but only the latter or eastward one was thoroughly examined. It is long and narrow, with irregular margins, covering an area of twenty-three thousand acres. Although nearly level, it has a sufficient slope for drainage from the sides towards the middle, and from east to west following the creek, which leaves it at the western end; but, on account of the resistance of the hard limestone over which the outlet flows, it has failed, as yet, to cut a passage deep enough to dry the ground, or wide enough to discharge the spring rains and melting snow. The report contains valuable discussions of the rainfall of western New York, of the ratio between rainfall and stream-discharge (taken largely from the invaluable reports on the Cochituate and Sudbury water-supplies for Boston), and of the proper size and slope for discharge-channels: it is accompanied by maps and sections. If legislators in other states, contemplating the advisability of establishing a survey of their domains, would examine p. 3 of this report, they would find the encouraging statement that it is "necessary to secure, as a basis for any adequate plans and propositions for successful drainage, *an accurate topographical map.*"

— The organization of the Yale college observatory is now proceeding quietly. The control of the observatory will come directly under the corporation, the old board of managers being abolished. The bureaus of horology and thermometry, on account of their outside relations, will be placed on a business basis.

— The American institute of electrical engineers, recently organized in New York, consists of members, honorary members, and associates. Members and honorary members are professional electricians and electrical engineers. Associates include persons practically engaged in electrical enterprises, and all suitable persons desirous of being connected with the institute. All members and associates are equally entitled to the privileges of membership.

At the meeting, May 13, officers were elected as follows: president, Norvin Green; vice-presidents, A. Graham Bell, Charles T. Cross, Thomas A. Edison, George A. Hamilton, Charles H. Haskins, Frank L. Pope; managers, Charles F. Brush, William H. Eckert, Stephen D. Field, Elisha Gray, Edwin J. Houston, G. L. Hillings, Frank W. Jones, George B. Prescott, W. W. Smith, W. P. Trowbridge, Theodore N. Vail, Edward Weston; treasurer, Rowland R. Hazard; secretary, Nathaniel S. Keith. —— A letter was read from C. J. Kintner, of the patent office, deprecating the large surplus turned into the U. S. treasury each year by the office, especially in view of the press of new inventions, which, in the electrical department, are now four months behind. —— Resolutions were passed, pledging the influence of the institute "to prevent any restriction of the rights and privileges of inventors, as they now exist under the laws, and that the institute of electrical engineers earnestly desires the passage of Senator Platt's bill, or its equivalent, in order that the work of the patent office may be put on a more efficient footing." —— Mr. Isaac Trumbo of San Francisco made some remarks on the state of electric lighting on the Pacific slope, and stated that he had been investigating various systems of lighting for use in the west.

— The sixteenth and seventeenth annual reports of the trustees of the Peabody museum have just been published in one volume. The curator, Prof. Fred. W. Putnam, gives the results of his important discoveries, made in 1882 and 1883, in certain mounds in Madisonville, in the Little Miami valley, Ohio, as well as of the explorations of others in Tennessee and Wisconsin, and of shell-heaps upon the coast of Maine. The Madisonville mounds have disclosed the interesting fact, that their builders made use to a limited extent of meteoric iron for the manufacture of ornaments, as is proved by the careful analysis given by Dr. Kinnicutt. Of even greater interest is the discovery of a series of pits, provided with flues, which appear to have been employed for the purposes of cremation, although Miss Fletcher has suggested the possibility that they were caches for storing valuables, which could be burned when liable to be captured by enemies. Mr. Putnam makes an almost passionate appeal to the patriotism of the American people for the preservation of the more important of the fast-disappearing relics of the remote past of their country. These reports are enriched by five most valuable papers by Miss Alice Fletcher, giving complete and heretofore unknown information in regard to the religious belief and the ceremonial observances of different Indian tribes. Mr. Carr has added an exhaustive examination of the social and political position of woman among the Iroquois, establishing incontestably the preponderating influence wielded by her. There is also a thoroughly scientific study by Miss Studley, with complete tables of measurements, of the osteology of human remains brought by Dr. Palmer from four caves in Coahuila, Mex. Lastly, Dr. Barrett has given interesting notes of his observations of numerous instances of dental disease occurring in ancient crania of the extensive collections of the museum. We regret that we have not space to give such an account as they merit, of these reports, which equal, if they do not surpass, in importance, any of the valuable contributions which Mr. Putnam has made to our knowledge of American antiquities.

— The summer course in botany, from July 7 to Aug. 16, at the botanic garden of Harvard university, Cambridge, Mass., will be given by Professor Trelease, of the University of Wisconsin. This course of lectures is designed to present, in a familiar way, the more important principles of botany of flowering plants. The elements of morphology, microscopic anatomy, and physiology of plants will be illustrated in the lecture-room by living specimens, by demonstrations and experiments. Laboratory work of two kinds will be provided, — 1°, for beginners; 2°, a course of laboratory practice for advanced students, comprising demonstrations in microscopic anatomy

and development, special attention being given to the study of cryptogams. The fees for lectures and laboratory practice will be twenty-five dollars. Applications for places in the laboratories should be made to Prof. G. L. Goodale, Cambridge, before July 6.

— Old Providence Island, recently visited by the U. S. fish-commission steamer Albatross, was in old times the favorite resort of buccaneers; and the ruins of their fortifications, even some of their ancient cannon, are still to be seen. A glance at the beautiful little harbor of Catalina and its surroundings reveals the wisdom of its selection as a rendezvous by the lawless freebooters. The island is entirely surrounded by dangerous reefs, the entrance to the harbor being narrow, somewhat tortuous, and commanded by their batteries on shore. Ample supplies of wood, water, fresh meats, fruit, and vegetables, could be procured from the inhabitants, with whom they made it a point to be on friendly terms. Its location near to, but outside, the great routes of commerce, made it particularly valuable for their purposes.

The island belongs to the United States of Colombia, and has a population of about eight hundred, the Indian blood predominating; but there is a large African element. The English language is universally spoken, and the Protestant religion is the only one professed by the people. Schools are maintained, and it is the exception when a native is unable to read and write. The climate during the dry season, from November to May, is tempered by the trade-winds, which blow constantly, and is probably unexcelled by that of any island in the West Indies. There is no physician on the island, and the lack of proper medical attendance causes great suffering among the inhabitants. Dr. Herndon had a room fitted up on shore, and gave his whole time to the sick who came or were brought to him, the ship furnishing such medicines as could be spared.

As soon as they anchored, an officer was sent on shore to call on the magistrate, and to inform him of the mission of the Albatross. He received the officer very cordially, and offered every assistance in his power. The naturalists commenced work at once, and succeeded in making a very creditable collection. A large variety of fish was procured for specimens, and an ample supply for officers and crew was caught with the seine. Fresh beef, poultry, sweet-potatoes, yams, and fruit were plentiful at fair prices. Tortoise-shell and cocoanuts are articles of export.

— The German foreign office means to send a commissioner to the west coast of Africa, on whose report it will depend whether a German man-of-war shall be stationed in those waters, or not. Dr. Nachtigall, the German consul in Tunis, has been intrusted with this mission. He will be accompanied by Dr. Büchner, the explorer, and by a member of the German embassy in London. The gunboat Möwe has been sent there to supersede the corvette Sophie.

— The German government has awarded 135,000 marks to Dr. Koch for his services on the International cholera commission.

— The German iron and steel industry society is publishing an illustrated work on the uses of iron and steel in the building-trade, giving full directions for any workman to apply for himself. The expenses will amount to £1,750, and the members of the society call upon all interested in the iron-trade to contribute towards them.

— From *Nature* we learn that the electrical congress of 1884 adjourned, after deciding on the standard value of the ohm as satisfactorily as may be at present. It must, however, be considered as little short of disappointing, that no better standard of light could be suggested than that emitted from a square centimetre of platinum at the temperature of fusion; and in requesting that "the results of observations (of earth-currents) collected by the various administrations be sent each year to the International bureau of telegraph administration at Berne," the committee simply stated that they had nothing to report. M. Mascart grouped the results of ohm determination in the following useful table: —

Methods.	Experimenters.	Column of mercury in centimetres.
1. B. A.	British Association	104.83
	Rayleigh-Schuster	106.00
	Rayleigh (1882)	106.27
	H. Weber	106.16
2. Weber (I.)	Kohlrausch	105.81
	Wiedemann	106.19
	Mascart	106.33
3. Kirchhoff	F. Weber	105.02
	Rowland	105.79
	Glazebrook	106.29
	Mascart	106.33
4.	Röiti	105.90
5.	Fr. Weber	105.33
6. Lorenz	Lorenz (first)	107.10
	Rayleigh	106.24
	Lenz	106.13
	Lorenz (second)	106.19
7. Weber (II.)	Dorn	105.46
	Fr. Weber	105.26
	Wild	105.68
	Baille	105.37
8. Heat	Joule	106.22

From this it appears that the figures obtained by the different methods were —

B.A.	106.21
Weber's (I.)	106.14
Kirchhoff's	105.93
Lorenz	106.19
Weber's (II.)	105.47
Joule	106.22

the mean of which was 106.02; but 106 was taken as a round figure, sufficiently near the truth for all practical and useful purposes: hence the congress decided that "the legal ohm should be the resistance of a column of mercury of one square millimetre section, and of 106 cm. of length at the temperature of freezing."

— Among those granted prizes this year by the French academy were, in geometry, Emile Barbier; in mechanics, Marcel Desprez; for his experiments

on electric transmission of power, in astronomy, Bouquet de la Grye, de Bernardières, Courcelle-Seneuil, Fleuriais, Hatt, Perrotin, Bassot, Bigourdan, and Callandreau, for their observations of the transit of Venus in 1882; Stephan, the Vally prize; in physics, Henri Becquerel; in chemistry, Etard and L. Cailletet, for his researches on the liquefac-of gases; in geology, Fontannes for his work on the basin of the Rhone, and Péron for his account of the geology of Algeria; in botany, Joannès Chatin for his studies of trichina, and G. Bonnier, L. Mangin, Klein, Ch. Maguier, Costantin; in physiology, Paul Regnard, and Balbiani; in aeronautics, Gaston Tissandier, Duroy de Bruignac, and V. Tatin.

— The following resolutions were passed at the Ornithological congress of Vienna: 1°. The chase, capture, and trade of birds of passage and their eggs should be forbidden during the second half of the winter and in the spring; 2°. All wholesale capture of birds of passage, and trade in them, should be forbidden, except during the hunting-season.

Dr. Karl Russ of Berlin received the highest honor diploma of the congress, for his works on bird-keeping, canaries, parrots, and his journal called the *Feathered world.*

— Parts xxvi. and xxvii. of Bütschli's 'Protozoa' have just appeared, and nearly complete the Flagellata. Kent's unsatisfactory classification is set aside for a new and more scientific system. Nearly two hundred species are known, divided into a hundred and ten genera. Bütschli reduces the number of genera, which might otherwise soon exceed the species, and establishes the following sub-orders: Monadina, Englenoidina, Heteromastigoda, and Isomastigoda. Although the work was originally planned to be complete in fifteen parts, and twenty-seven have already appeared, the Infusoria, and the general chapter on the Protozoa, are still to come.

— The *Illustrirte zeitung* states that the recommendations of the German cholera commission are being put in force at Hyderabad, especially with reference to the water-supply; the reform being hastened by the young Nizam having an attack of cholera.

— The death of Dr. Paul Pogge, the celebrated African traveller, is a loss to the German-African exploration society. He started from Loanda with Lieut. Wissmann; from Nyangure, on the Kongo, he returned, sending his companion to Zanzibar; from Loanda he meant to start on fresh explorations, but died.

— The last (fifth) report of the Archaeological institute of America is principally occupied with an account of the explorations, carried on for the society last year by Mr. Bandelier, in New Mexico and Arizona. An excellent map illustrates his various routes; and, in an extended report, he gives the conclusions he has drawn mainly from his architectural studies, of the different ruins investigated. He finds a well-defined system of growth from the temporary Indian lodge, to the many-storied pueblo building, which clearly does not owe its origin to any external influence. Mr. Bandelier is now in the mountains of northern Mexico, seeking for traces of any possible connection between the ancient Pueblos and the Aztecs; and it is announced that the report of his important studies in Mexico, in 1881, at Cholula and at Mitla, is nearly ready for publication.

Of the work in classical archeology, carried on by the institute, an account is given of the conclusion of the explorations at Assos, in Asia Minor, owing to the expiration of the three years' firman granted for that purpose. The main efforts of the past year have been expended upon the Agora and the Necropolis. A fair division of the objects discovered was arranged with the agent of the Turkish government; and two fine bas-reliefs from the temple of Athena, the human-legged centaurs and the heraldic sphinxes, have been received by the Museum of fine arts in Boston. Mr. Clarke is now in London, preparing a complete report of the explorations. The total cost of this expedition, so important for the knowledge of classical antiquity, and so honorable to American scholarship, has been a little more than nineteen thousand dollars. Appended is the third annual report of the committee on the American school of classical studies at Athens.

— Ostrich-farming is a new business, unknown till the English colonies of South Africa realized such wonderful results. We have already given some statistics of their enormous increase. The ostrich lays a minimum of forty, a maximum of sixty, eggs in a season, weighing about three pounds each, and which are laid in the sand, and left to hatch in the hot regions; but in cooler regions the male and female birds sit on the nest by turns, defending it with great courage. Forty days is the time for incubation. Since the importation of domestic ostriches into the United States, the South African farmers have become fearful of losing their great profits in case of a successful competition springing up.

— The *Academy* announces the death of Señor Don Eulogio Jimenez of the observatory at Madrid, one of the first mathematicians of Spain, and author of '*La teoria de los numeros*' and many educational works on mathematics, both original and translated.

— A coal-steamer, the Loch Garry, has left St. John's with five hundred tons of coal for the Greely search party, and materials for a house; these supplies to be landed on Littleton Island. The Bear got away from St. John's before any of the whaling-fleet, except the Norwhal, a slow vessel. The Thetis will convoy the coal-steamer as far as possible; and, in case of separation, they are to meet at Disco.

— The French association for the advancement of science will hold its thirtieth meeting in the town of Blois, from Sept. 4 to 11.

— The Franklin institute wishes to make a loan-collection of pieces of electrical apparatus of historic interest, one feature of the approaching electrical exhibition, and has issued a call to those having such pieces to send them to Philadelphia, where the proper care is guaranteed. Edwin J. Houston is the chairman of the committee on the historical electrical apparatus.

SCIENCE.

FRIDAY, JUNE 6, 1884.

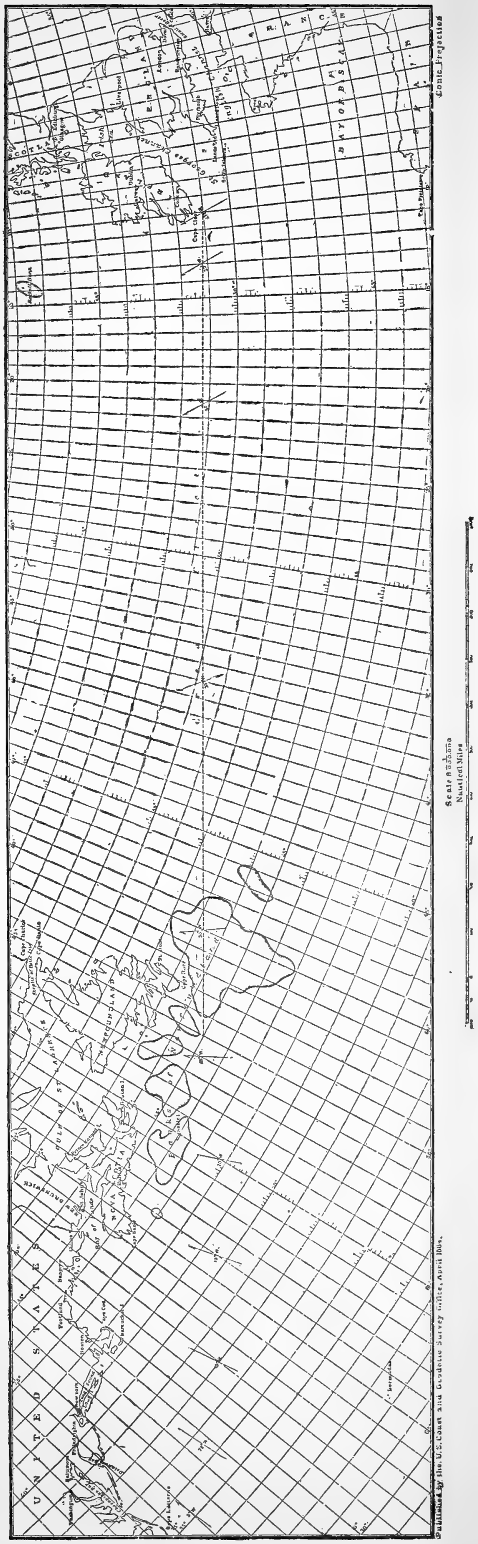
COMMENT AND CRITICISM.

THE rapid strides made in all departments of science, and the fundamental revolutions in some of them, have increased the demand of the public and of publishers for books which shall expound, in clear and simple language, the latest discoveries. Yet publishers look at such books in some measure askance, unable, as a rule, to judge for themselves of their probably permanent or ephemeral value, and always with a very reasonable fear that they will speedily prove antiquated, and become a drug in the market. An apparent attempt to evade the little financial dilemma which the advance of knowledge presents to the vender of literary wares has recently been brought to our notice. Four books, sent us at one time for review, were first examined to see whether they were of sufficiently recent date to notice. *They bore no date.* A careful examination showed that one of them consisted of lectures delivered two or three years ago, but no clew to the age of the others could be found. It was tolerably evident that the very unusual omission was intentional. If intentional, it was, to say the least, a deliberate purpose to evade the purchaser's natural and proper question, Does this book represent present knowledge? We leave to the 'Society for the promotion of Christian knowledge,' whose imprint each of these books bore, to ask itself the question, Is such a practice defensible on the grounds of scientific, Christian, or even pagan morality?

IT is a question to be considered, whether our smaller societies of natural history, to whose meetings we desire to call attention in the columns of *Science*, do not make a mistake in having no plan of work towards the accomplishment of which they can make a united effort, instead of pursuing observation and discussion almost at random. Larger societies in the cities, where publications, and even general collections, are attempted, must naturally cover a broad field: it is not to these that we refer, but to the smaller societies that spring up, too often for but a short life, in our country towns. The desire for large membership, and the admission of members to full standing without any requirement of work accomplished, seems to us another error. Five really industrious members make a very good nucleus for a local club. Others can be added later, on the assurance of some task of local observation actually performed, and of willingness to co-operate towards some attainable end; and beyond this there may, of course, be general meetings, as public and as fully attended as possible, but full membership should in all cases mean work done.

THE coast-survey has just published a 'North-Atlantic track-chart,' executed with the beautiful neatness characteristic of its work, "to illustrate the point, that, in the conic projection, the straight line upon the plane surface of the chart almost exactly represents the great circle contained between its termini, which on other projection will do." A reduced facsimile of the chart will be found on the next page. If this be demonstrated to obtain with sufficient closeness for all latitudes and all courses, the conic projection, in which a part of the earth is represented on a conical surface, tangent or secant about the middle latitudes of the region represented, should replace the common Mercator's or cylindric projection of ordinary sailing-charts, in which great distortion is caused by throwing the geographic lines on a cylinder tangent to the earth's equator.

The advantage usually quoted for the latter projection is, that it enables the navigator to lay out a course having a constant bearing



NORTH ATLANTIC TRACK CHART

throughout his ocean-voyage: but this advantage is largely fictitious; for, with better knowledge of winds and currents, it is now seldom found advisable for sailing-vessels to follow such a route; and steamers, that can afford to pay little attention to the weather, prefer the great circle, or shortest-line course, to the longer one, so easily determined on the Mercator chart. The difficulty that stands in the way of the general adoption of great-circle sailing is the complexity of the calculation required in laying out the track to be followed. If this difficulty can be overcome by the use of the conic projection, then the owners of vessels desirous of quick passages can hardly fail to demand its introduction.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

A colt and its mother's blanket.

MY attention was called recently to the peculiar actions of an orphan colt, which perhaps are worth recording. When the colt was two weeks old, its mother died. Previous to her death, she was covered with a blanket. When it was apparent she could not live, the blanket was thrown over the fence, and the mare removed, and the colt left in the enclosure. The colt was very much exercised at first, ran up and down the yard neighing; but, when it came near the blanket on the fence, it stopped, smelled of it, and seemed pacified. It evidently considered the blanket its mother, and has continued to do so.

If the blanket is removed from the fence, the colt becomes restless, runs about neighing, but is reconciled by the sight of the blanket again.

If one throw the blanket over his back, the colt will follow the bearer all about.

It will graze about in the vicinity of the blanket, but will not go far away, and, when it wishes to rest, will go and lie down by it. F. L. HARVEY.

Fayetteville, Ark., May 20.

The invention of the vertical camera in photography.

In a footnote accompanying an article by Mr. Simon H. Gage, printed in this journal under date of April 11, 1884, on the application of photography to the production of natural-history figures, it was stated, that the only other persons employing a vertical camera in photography, known to the writer, were Dr. Theo. Deecke of the State lunatic-asylum at Utica, N.Y., and Dr. Dannadieu of Lyons, France.

As a matter of fact, the vertical camera, now used for photographing natural-history specimens, etc., is the outcome of a suggestion made in December, 1869, by Professor Baird to Mr. T. W. Smillie, the photographer in the U. S. national museum, Washington, D.C., that the instrument be placed on an incline; the former having observed the difficulty experienced in photographing with the horizontal camera such objects as stone implements, fish, etc. This sugges-

tion was acted upon; and in the following year (1870) Mr. Smillie invented the vertical camera, and with it introduced the use of a side-light, which produced the same effect as the skylight with the horizontal camera. Mr. Smillie also attached to the side of the apparatus an endless screw, whereby the distance could be readily regulated between the lens and the object to be photographed. In 1871, and again in 1875, a camera of this kind was constructed specially for photographing the marine animals taken by the U. S. fish-commission at Wood's Holl, Mass. Its advantages were readily seen by Professor Agassiz, who asked and obtained Professor Baird's permission to construct for his own work a camera on a similar principle. Not less than six thousand negatives have been taken with the vertical camera by Mr. Smillie. G. BROWN GOODE.

A tailed child.

The *Commercial* of this city for the 17th and 18th inst. gave accounts of a tailed child recently born here. As such cases are of scientific interest, and are very rare, a party of four, including a prominent doctor and the writer, concluded to investigate the case.

We found a female negro-child, eight weeks old, normally formed in all respects, except that slightly to the left of the median line, and about an inch above the lower end of the spinal column, is a fleshy pedunculated protuberance about two and one-half inches long. At the base it measures one and one-quarter inches in circumference. A quarter of an inch from the base it is somewhat larger, and from that it tapers gradually to a small blunt point. It closely resembles a pig's tail in shape, but shows no signs of bone or cartilage. There seems to be a slight mole-like protuberance at the point of attachment. The appendage has grown in length about a quarter of an inch since the birth of the child.

The mother, Lucy Clark, is a quadroon, seventeen years old, and the father, a negro of twenty, — both normally formed.

In Darwin's 'Descent of man,' vol. i. p. 28, he speaks of a similar case, and refers to an article in *Revue des cours scientifiques*, 1867–68, p. 625. A more complete article is that by Dr. Max Bartels, in *Archiv für anthropologie* for 1880. He describes twenty-one cases of persons born with tails, most of them being fleshy protuberances like the one just described. H. W. EATON.

Louisville, Ky., May 24.

Hibernating mammals.

In *Science*, No. 68, Dr. Merriam desires the evidence upon which my statements concerning the hibernation of certain mammals were based to be well sifted; and rightly, if it is true that my observations upset the well-known (?) laws that govern hibernation. Now, these 'laws' may be in force in the Adirondack region, but they are not in Central New Jersey.

I presume Dr. Merriam will admit that the squirrels and Hesperomys occasionally take a nap during the winter; that sleep is not wholly ignored by them. In my original communication (*Science*, No. 65), I stated very clearly that the Hesperomys slept much more during the winter months than at other times; that its hibernation consisted of such additional slumber, *and nothing more.* So far as the moles are concerned, I have never found evidence of activity in winter equal to that characteristic of the summer months; and specimens kept in captivity hibernated, in the strictest sense of that term, although food was kept within reach all of the time. Of course, star-nosed moles may get out of the reach of freshets; but I have never seen evidence of this, and have often dug down to their burrows immediately the freshet subsided, and found the animals where they were when the waters began to rise. Since the appearance of Dr. Merriam's critical remarks, I have thought the matter over, and believe it probable that these moles may close the openings to their burrows so effectually as to shut out the water from the central nest. This, it must be borne in mind, is a supposition only. In conclusion, I would state that I am not given to adducing facts in proof of general statements. Convinced of their essential correctness, I leave them with others to disprove or confirm by their independent observations. In the case of the 'hibernation' of certain mammals, a comparison of my original communication with the conclusions of my critic will show that there is no very marked difference in our impressions as to the habits of the animals named; and, whether 'extraordinary or improbable,' what I have said of the Hesperomys and star-nosed mole is not simply substantially correct, but absolutely so.

CHAS. C. ABBOTT, M.D.

May 25.

THE ROYAL SOCIETY OF CANADA.

THE third session of this society was held at Ottawa, commencing on the 20th of May, and ending on the 23d. Many members and delegates were present; among the latter, Dr. Persifor Frazer of Philadelphia, who represented the American association for the advancement of science, and Dr. C. Hart Merriam of New York, who represented the American ornithological union.

An address of welcome was presented to the new governor-general of the Dominion, the Marquis of Landsdowne, inviting him to become the honorary president of the society, to which his Excellency returned a suitable reply. The president's address was delivered by the Hon. P. J. O. Chauveau, in French, and the vice-president's by Dr. T. Sterry Hunt, in English.

On the 22d of May the members and friends of the society were invited by the Ottawa field-naturalists' club to participate in an excursion to the King's Mountain, near Chelsea, in the Laurentian country to the north of the city, which proved eminently successful.

The following officers were elected for the ensuing year: president, Dr. T. Sterry Hunt; vice-president, Dr. Daniel Wilson; treasurer, Dr. J. A. Grant (re-elected); honorable secretary, Mr. J. G. Bourinot (re-elected).

The two scientific sections of the society are the third (mathematical, physical, and chemical sciences) and the fourth (geological and

biological sciences); and our account covers only the more interesting or important papers in these two sections. A full list will be found in our Notes.

In the physical section, Mr. F. N. Gisborne, the superintendent of the government telegraph-service, described a new system, devised by himself, to obviate the evil effects of electrical induction in underground and aerial conductors. A number of diagrams were presented, illustrating the conditions obtaining in neighboring circuits; and two or more circuits arranged in the ordinary way, and the same arranged according to his method, were compared. The advantages of the latter arrangement were clearly set forth; and proofs of its efficiency were presented in a tabular statement of experiments made with a section of cable about three thousand feet in length, constructed under his direction, and laid underground between two of the departmental buildings in Ottawa. The cable contains twenty indifferently insulated conductors or wires, which are divided into pairs, two conductors being twisted together in each case. Each pair constitutes a metallic circuit, one conductor being used as a 'return,' instead of the earth-plates usually employed. The peculiarity of the invention consists in the twisting of these metallic circuit conductors, as both wires are thus made to occupy an equidistant relationship with respect to any other conductor or pair of conductors in their vicinity. It was explained, that, by this device, a current introduced into a circuit is conducted down one wire, and up the other; and, the position of both wires being the same with respect to neighboring circuits, the inductive effect of the current passing down one wire is neutralized by the inductive effect of the same current passing up the return-wire.

It was also theoretically demonstrated that the twisting of the wires of the metallic circuits lessens the effect of induction of the current upon itself. When the wires of a metallic circuit are laid parallel throughout, the current induced from one wire into the other is in the same direction as the current itself passing in that wire; the effect of the current is therefore prolonged, and retardation experienced in a marked degree: whereas, when the wires are twisted closely (say, two turns to the inch), the wires occupy throughout their length a position approaching right angles with respect to each other; and the induced currents are thereby materially lessened, and retardation rendered less appreciable.

In the discussion which followed the reading of the paper, it transpired, that if a conductor were enclosed and insulated within another conductor (such, for instance, as a gutta-percha covered wire drawn through a metal tube), and both conductors were connected at either end with earth-plates, or other conductors, so as to form two independent closed circuits, the enclosed conductor might be employed to convey electrical currents, without any inductive effect being perceived, in a circuit extending parallel with, or in the neighborhood of, the outside conductor. The explanation of this condition is, that the outside conductor, which in this case cannot be used as a medium for communication, intercepts the induced currents on all sides of the inducing circuit, and in its closed circuit absorbs them.

As in such a system the outside conductors could not be utilized in the formation of circuits for purposes of communication, it is admitted, that, apart from the bulkiness necessarily attending it, the first cost of construction upon that plan renders the system comparatively impractical; whereas, in the system advanced by Mr. Gisborne, the construction is much cheaper, and all the conductors form an integral part of the communicating circuits, so that space is economized to the fullest extent.

A good deal of interest is being manifested in this invention which Mr. Gisborne has just now brought forward, although it has been a subject of investigation with him for some years past, the cable referred to in the paper having been ordered by the Dominion government during the summer of 1882.

Mr. R. Steckel presented a paper on the form of the contracted liquid vein, affecting the present theory of the science of hydraulics, in which the author claims to propound a new theory of the efflux of liquids, and describes experiments by which he has sought to test it.

Dr. T. Sterry Hunt, in his paper on the origin of crystalline rocks, maintained, in opposition to the plutonic and metamorphic hypotheses of the origin of these rocks, a new one, designated the *crenitic* hypothesis (Greek, κρήνη, 'a spring'), according to which they were formed, at an early period of the earth's history, by the agency of circulating subterranean waters rising to the earth's surface as springs. He supposes the previous existence of a chaotic layer, the last-congealed portion of a globe consolidating from the centre; which layer, rendered porous, and permeated by waters, gave up to them the materials of quartz and the felspars, after the manner of zeolites, to be deposited at the surface. The action of non-aluminous silicates, allied to pectolite or the

magnesian salts in sea-water, was the source of serpentine, pyroxene, etc. The gradual removal by solution from below, of vast quantities of material, and the resulting contraction of the primitive stratum, caused the universal corrugations of the upper acidic or gneissic layer. From the undissolved basic residual portion have come such eruptive rocks as melaphyres and basalts, while granitic and trachytic rocks are softened and displaced portions of the acidic or secondary layer. The author has developed at length this hypothesis, which, according to him, affords a satisfactory explanation of many hitherto unsolved problems in geology.

In a paper on the density and the thermal expansion of aqueous solutions of sulphate of copper, Prof. J. G. MacGregor gave an account of extended observations made to determine the density of solutions of different degrees of concentration, and at different temperatures. As a general result of the experiments, it is shown, 1°, that the rate of variation of density with temperature in all cases increases with the temperature and with the degree of concentration; 2°, that at low temperatures (below about 25° C.) the rate of change of density with temperature is for all solutions greater than the same rate for water; 3°, that the difference between these rates diminishes as the temperature increases; and, 4°, that for most solutions (probably for all) these rates are, at sufficiently high temperatures (30°–50°), the same as for water, i.e., the thermal expansion of solutions is the same as that of water at these temperatures. The experiments also substantiate a result formerly obtained by Professor Ewing and the author, that very weak solutions of this salt have a volume smaller than that of the amount of water which they contain.

Prof. E. Haanel gave a continuation of his paper, presented to the society last year, on blowpipe re-actions on plaster-of-paris tablets, in which he described the effect of treating copper with hydrobromic acid, and iron with hydriodic acid, and showed how to distinguish between selenium and mercury. He described also the coatings *per se*, for the above tablets, for selenium, tiemannite, arsenic, silver, alloys of bismuth, lead, and antimony with silver, galena, orpiment, realgar, mercury, tellurium, carbon, cadmium, and gold.

The same author gave a description of apparatus for distinguishing flame-coloring constituents when occurring together in an assay. The apparatus consists of a spectacle-frame, furnished for the left eye with plain colorless glass, and, for the right eye, with four glasses, — red, green, violet, and blue. These glasses revolve on an axis, and can be brought, either separately or in any combination, before the right eye of the operator.

Prof. N. F. Dupuis showed how to develop by simple algebraical methods certain functions ordinarily developed by the aid of the calculus.

Prof. E. J. Chapman described a series of analyses of magnetic and other iron ores from samples obtained by him personally from various parts of Ontario. The geological conditions of the deposits were also briefly given.

In the geological and biological section, Dr. A. R. C. Selwyn gave an account of his observations, in 1883, on the geology of a part of the north shore of Lake Superior, in which he considered he was able to show that the great masses of columnar trap which form the summit of Thunder Cape, Pie Island, and McKay's Mountain, were not part of a 'crowning overflow,' as they have been described to be, and newer than the Keweenawan series, but that they are contemporaneous with the black slaty shales of the Animikie group, which immediately and conformably underlie them.

Professor George Lawson presented a revision of the Canadian Ranunculaceae. The author referred to his monograph of Ranunculaceae, published in 1870, to the extensive collections that had been subsequently made, and to works published upon the North-American flora, — all of which enabled a fuller and more accurate description of Canadian ranunculaceous plants to be given now than was possible when the previous paper was prepared. The greater precision given to recent observation had also enabled the geographical range of these plants to be stated more fully. The striking diversity of modification in the form, number, and arrangement of the several parts of the flower and of the fruit, in the several genera, was pointed out. The number of Canadian species is seventy-eight, and of varieties eighteen.

Dr. T. Sterry Hunt presented a second part of his essay on the Taconic question in geology, in which he endeavored to show in the first place, more fully than has yet been done, the relations of the Taconian or lower Taconic series of stratified rocks to the succeeding Cambrian, or upper Taconic, which some geologists have confounded with the Taconian. In this connection is given a critical discussion of the studies of Perry, Marcou, and others, and the opinions of Dana, as regards the Cambrian of the Appalachian region of North America. In the second place is considered

the probable equivalence of the Taconian to the Itacolumite series of Brazil, and to similar rocks elsewhere in South America and the West-Indian Islands, as well as in Hindostan and southern Europe. All of these comparative studies, it is said, tend to establish the distinctness of the Taconian as a great and widely spread series of crystalline stratified rocks, occupying a horizon between the Cambrian and the Montalban or younger gneiss series of Europe and North America.

Some deposits of titaniferous iron ore in the counties of Haliburton and Hastings, Ontario, were discussed by Prof. E. J. Chapman. After referring to the occurrence of numerous deposits of magnetic iron ore in certain zones or belts of country in the counties of Victoria, Haliburton, Peterborough, and Hastings, he described their conditions of occurrence as those of large, isolated masses or 'stocks,' — forming, in some cases, sheathed stocks, or *stockscheiders* and *skölars*, of German and Swedish miners, — as in the great iron-ore zone of Arendal, in Norway. While these stock-masses of iron ore are, for the greater part, quite free from titanium, one of vast size in the township of Glamorgan, and another equally large mass in Tudor, are shown to contain a considerable amount of titanium. Detailed descriptions of these were given, with analyses of the ore.

Prof. E. J. Chapman also read an essay on mimetism in inorganic nature. Mimetism, as recognized in organic nature, has been regarded, on the one hand, as the direct result of a protecting Providence, and, on the other, as originating in minute approaches towards the imitated object; these becoming intensified in successive generations until the imitation becomes complete, or reaches its extreme limit. In this paper, the writer attempts to show that neither hypothesis may be absolutely correct, but that the peculiarity may be due to some occult law of 'localism' by which associated forms often become impressed with mutual resemblances. In support of this view, he refers to several curious cases in which certain minerals, normally and generally of very dissimilar aspect, become closely mimetic under certain local conditions; as seen in examples of quartz and zircon, pyroxene and apatite, etc., in the phosphate deposits of the Ottawa region.

A monograph of Canadian ferns was offered to the society by Dr. T. J. W. Burgess and Prof. J. Macoun. Professor Macoun stated, that twenty years ago the total number of ferns known to occur in Canada was forty-six, while at the present time it had increased to sixty-three. In illustrating the range of the more interesting species, he particularly noticed the occurrence of Phegopteris calcarea in Anticosti, where he had found it in 1882, and remarked that the same plant had recently been collected by Drs. G. M. Dawson and R. Bell in the country around and to the east of the Lake of the Woods.

Prof. L. W. Bailey, in a paper on geological contacts and ancient erosion in the Province of New Brunswick, summarized the more important and well-established lines of physical contact between the geological formations of New Brunswick as bearing upon the relative age of the latter, and the disturbances to which they have been subjected. Three well-marked breaks, separating groups of widely diverse character were recognized among pre-Cambrian strata, — the supposed equivalents of Laurentian, Huronian, and possibly Montalban horizons; a very marked one at the base of the Cambrian; and others successively between later formations to the base of the trias. The evidence of such breaks was shown to be of various character, including discordance of dip and strike, overlap, igneous extravasations, and intermediate erosion; and the bearing of the facts determined on the physical and geological history of north-eastern America was briefly discussed. The granites, which constitute so marked a feature in the geology of the Acadian provinces, were described as intrusive, and as the cause of the extensive alteration exhibited by the formations which they have invaded. The erosion which accompanied or followed upon the disturbances described was shown to have been enormous.

Mr. G. F. Matthew continued his illustrations of the fauna of the St. John group by presenting a paper on the Conocoryphidae, with notes on the Paradoxidae. The species of Conocoryphe referred to and illustrated are C. Matthewi Hartt (with three varieties), C. elegans Hartt, C. Baileyi Hartt (with two varieties), and a new form which the author describes as C. Walcotti. Critical remarks are also made upon Paradoxides lamellatus Hartt and P. acadicus.

In a description of a supposed new ammonite from the upper cretaceous rocks of Fort St. John, on the Peace River, Mr. J. F. Whiteaves considered it to be an undescribed species of Prionocyclus, closely allied to the type of that genus (Ammonites Woolgari of Sowerby), but with much more closely coiled volutions. It occurs in flattened nodules, in shales which are believed to be the equivalents of the Fort Benton group of the Upper Missouri section.

THE MIDDLE YUKON.[1] — I.

THE extent of the Alaska military reconnoissance of 1883 was so great that I deemed it best to divide the account of it into convenient sections; and the three subdivisions, of which this is the second, have already been explained as made *wholly with reference to my own travels.* It was therefore not intended as a geographical division of this great river, although it would not be altogether unavailable even for this purpose. The Middle Yukon, with reference to my expedition, extends from the site of old Fort Selkirk to old Fort Yukon, — a part of the river which we know in an approximate manner by the rough maps of the Hudson-Bay traders, who formerly trafficked along these waters, some envoys of the Western union telegraph company, and a few others. This part of the river, therefore, had been explored; and to my expedition fell the lot of being the first to give it a survey, which, though far from perfection, is the first worthy of the name, and, I believe, sufficient to answer all purposes until commerce is established on the river subservient to the industries, either fishery or mineral, that may spring up along it.

[1] See *Science*, Nos. 55, 56.

I have spoken, in my previous article, of the comparative sizes of the Pelly and the Lewis, showing the latter to be undoubtedly the Yukon proper; and the view (fig. 1) taken looking into the mouth of the Pelly from an island at the junction of the two, and that (fig. 2) looking back up the Yukon from the site of old Selkirk, show the evident preponderance of the latter, although, in the case of the Pelly, but one of its mouths, the lower and larger one around the island, can be seen distinctly. The perpendicular bluff of eruptive rock, distinctly columnar in many places, and with its talus reaching from half to two-thirds the way to the top, shown in the first view, extends up the Pelly on the north bank as far as it was visited, some two or three miles, and continues on down the Yukon on the same (north) bank for twelve or thirteen miles, when the encroaching mountains obliterate it. In but one place that I saw was there a break, so that one could climb from the bottom, over the *débris*, to the level plateau that extended backward from its crest; although in many places this plateau could be gained by alpine climbing

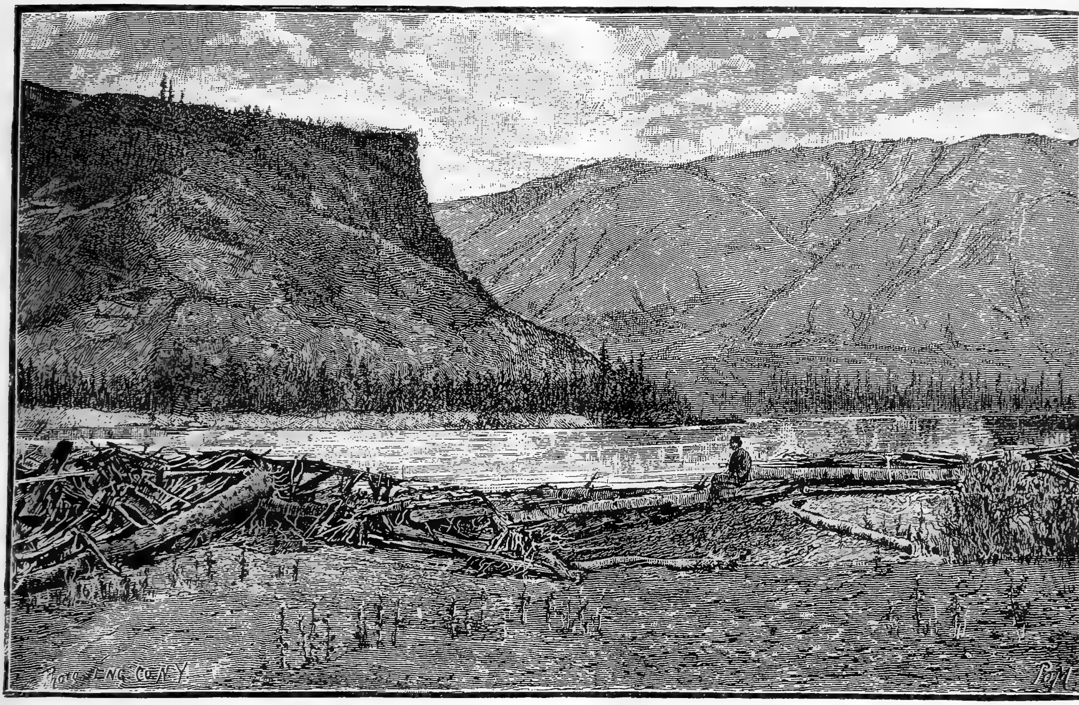


FIG. 1. — YUKON RIVER: VIEW LOOKING INTO THE MOUTH OF THE PELLY RIVER.

up the crevices in the body of the rock. The plateau is not very wide before the foot of the high rolling hills is gained. In fig. 1 the constant barricades of driftwood, met everywhere on the many islands of these rivers, are shown, and are much below the average in amount; the heads of the islands being often piled up with stacks ten to twenty feet high, forming more or less a protecting dam, in freshets, from the eroding power of the swift water.

An Ayan (or Iyan) Indian grave some two or three months old, on the bank of the river From the grave itself there is erected a light pole twenty to twenty-five feet high, and having some colored cloth flaunting from its top; although in this identical grave the cloth was white, or, rather, dirty white. Not far away, always close enough to show that it is some superstitious adjunct of the grave, is another pole of about equal height; and to its top there is fastened a poorly carved figure of a fish, duck, goose, or bear, which, I think, designates the sub-clan to which the departed belonged. This pole may be, and often is, a fine

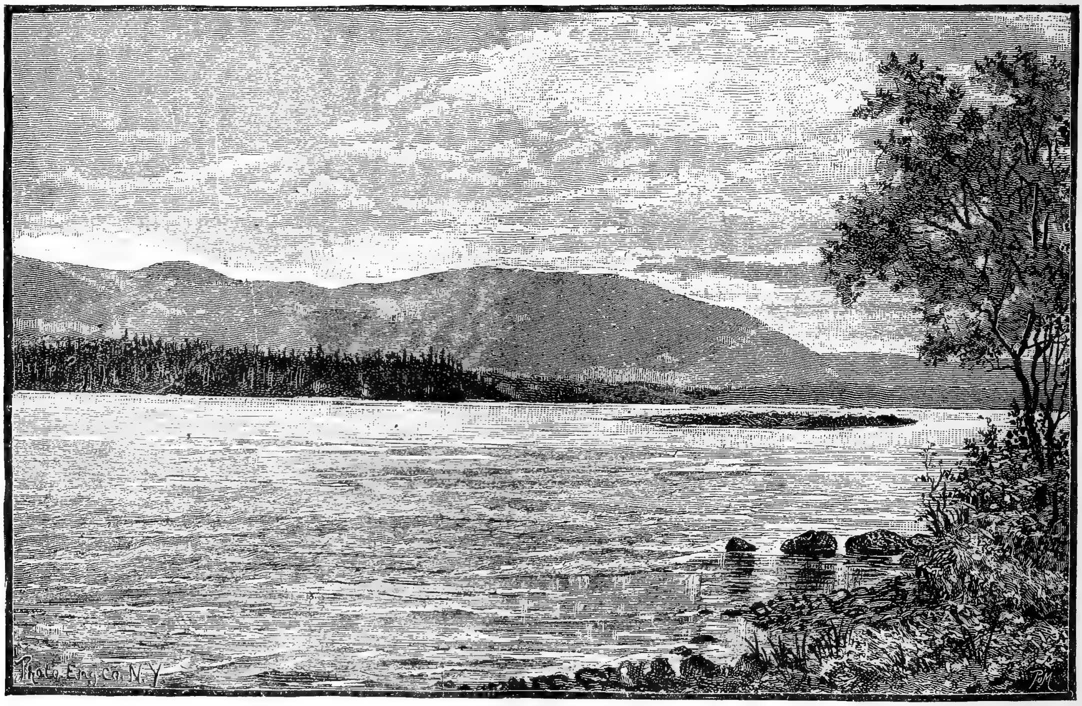


FIG. 2.—VIEW LOOKING UP THE YUKON FROM THE MOUTH OF THE PELLY.

near the site of old Fort Selkirk, was a typical one of the many we saw from here to Fort Yukon. The body is bent up, with the knees to the breast, so as to take as little space as possible, and enclosed in a very rough box of hewn boards two and three inches thick, cut out with their hand-axes, and then buried in the ground, the lid seldom being over a foot or a foot and a half below the surface. The grave-enclosure is made of roughly hewn boards, four corner-posts being prolonged, and rather neatly rounded into a design represented in fig. 3, and from which they seldom depart. It is lashed at the top by willow withes, and one or two stripings of red paint are just below this.

young tree of proper height and convenient situation, stripped of its limbs and bark. The 'totem' at the top is sometimes made as a weather-vane, or probably it is easier to secure firmly by a pin driven vertically; and it becomes a sepulchral anemoscope without their intending it for any such meteorological object. These poles may be striped with red paint, and the outside pole has one or several pieces of cloth hung from its length. The graves are always near the river-bank, and, when fresh and white, can be seen for many miles. There is no tendency whatever to group them into graveyards, beyond the fact that they are a little more numerous near their semi-permanent vil-

lages than elsewhere, the ease of interment being evidently the controlling cause of location. Leaving out the poles, there is a strong resemblance, in a rough manner, to civilized graves; and no doubt much of its form is due to the direct and indirect contacts with civilization, as my own Indians (Chilcats) told me that they formerly placed their dead on pole scaffoldings in the branches of trees, somewhat after the manner of the Sioux; and in one instance a very old and rotten scaffold in a tree was pointed out to me as having once subserved that purpose, although no surroundings confirmed the story; but these could have easily been obliterated.

We succeeded in getting a photograph (fig. 4) of a group of Ayan or Iyan Indians, with their birch-bark canoes. It was very hard work to keep them still; and, as far as fineness of features is concerned, the photograph was not perfect. Their birch-bark canoes are the best on any part of the river in lightness, compactness, and neatness of build and design. The paddle, well shown in outline in the hands of one of the group, is of a cross-section shown in fig. 5, the ridge or rib, r, being always held to the rear in using it. In addition to the paddle, there are two light poles for each canoeman, about as long as the paddle, and as heavy as its handle; and these are used in ascending the river by keeping near the shore, and using one on each side of the canoe, poling against the bottom. So swift is this great river in these parts, that they use no other method in ascending it, except for very short distances. In descending, the current is the main motive power, especially for long journeys, and the paddle is only leisurely used to keep them in the swiftest part of the stream. When they desire, however, they can go at a gait that few canoemen in the world, savage or civilized, could equal.

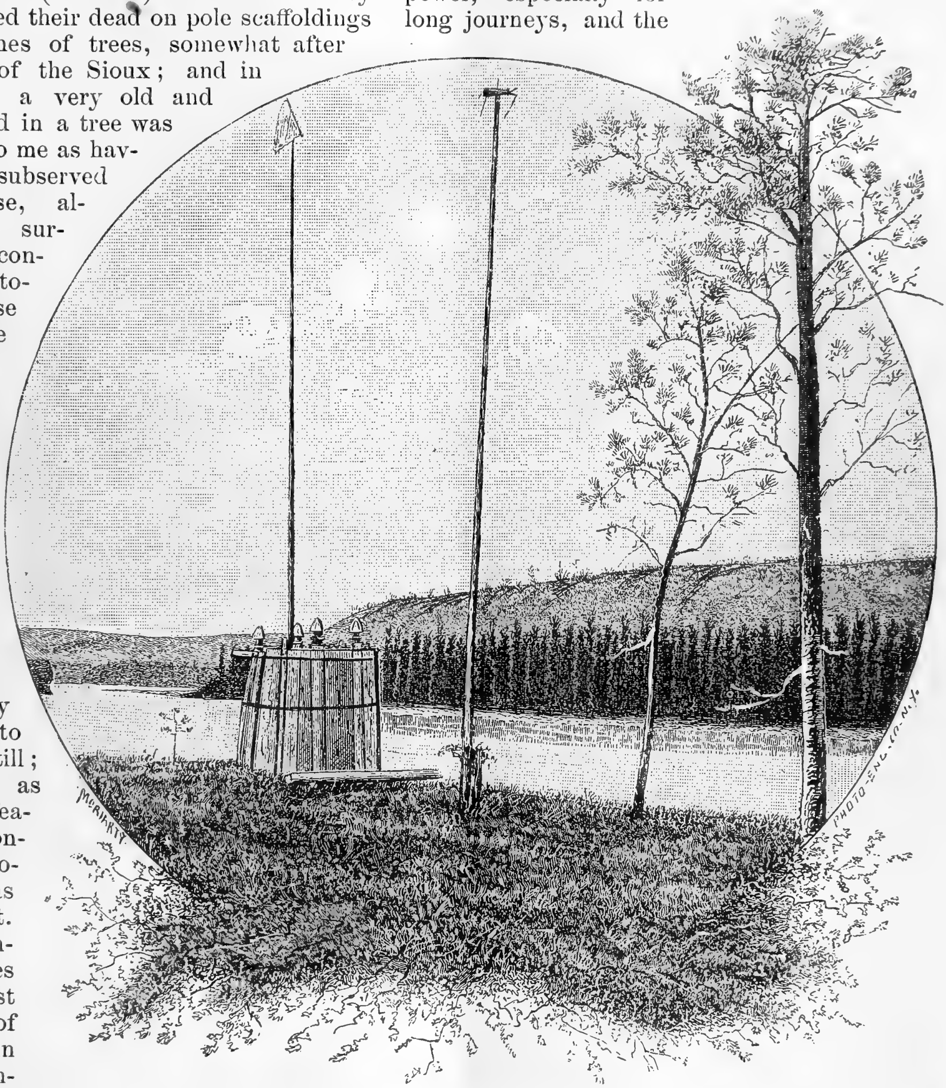


FIG. 3.—LOOKING ACROSS THE YUKON. THE BLUFFS ARE OBSCURED BY THE HIGH SPRUCE-TREES ON THE ISLAND, THE HILLS BEYOND SHOWING ABOVE.

A couple of species of fish were caught near the site of Selkirk,—the grayling being the

same kind that was caught in such immense numbers near Miles' Rapids, and observed in varying numbers from Perthes Point, on Lake Bove, to the mouth of White River, averaging a trifle over a pound in weight; and a trout-like salmon, caught sparingly from Lake Nares to White River, occasionally with a fly, but more often on the trout-lines put out over night.

We got away from Selkirk, July 15, at 1.15 P.M., having waited for a meridian culmination of the sun for an observation for latitude. Although we had understood from the Indians that had visited us, that their village was but a few miles below Selkirk, we had become so used to weak, straggling numbers of natives, that it was a great surprise when we rounded the lower end of an island, about 4 P.M., to see from a hundred and seventy-five to two hundred Indians on the south bank of the river, ready to receive us; our coming having been heralded, evidently, by advance couriers, and all of them apparently half frantic with excitement for fear that we would drift past without visiting them. A line was thrown ashore, and every man, woman, and child got hold of it, and the great bulky raft was swung in as if it had been a canoe.

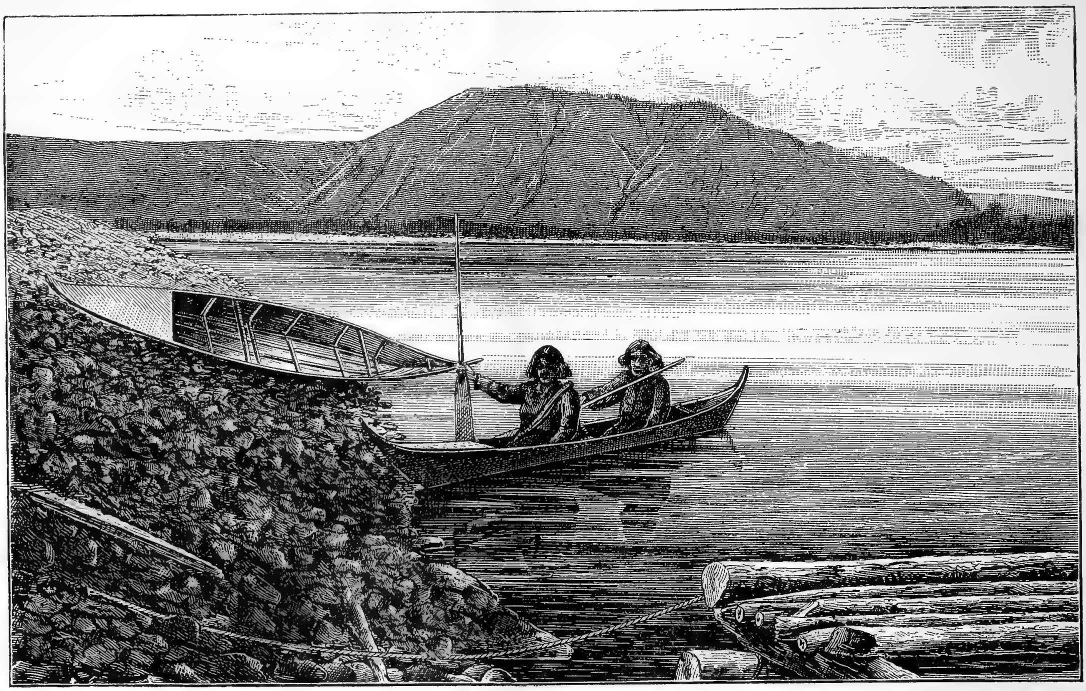


Fig. 4.—Ayan Indians and their birch-bark canoes.

Fig. 5.

From previous explorers on the river, I had been deluded into the idea that useful articles — as knives, saws, and files — were the best for trading-purposes, the purchase of native work, and payment of services; but I soon found this to be erroneous, for the constant burden of their solicitations was for tea and tobacco, small quantities of which they get by barter with intermediate riparian tribes. These desires I found to extend the whole length of the river; and, as the former article is light, I would especially recommend it to those entering that country to pursue scientific research, for which there is such a grand field.

Fig. 6.

These Indians call themselves the Ā-yans, with an occasional leaning of the pronuncia-

tion towards Ī-yan; and this village contained the majority of the tribe. The village was called Kah-tun^g, also Tah-kon^g or Tahk-ong (*tahk* seeming to be a root in the language of this country: *vide* Tahk-heesh, Tahk-heen-a, Tahk-o, etc.). It was of a semi-permanent character; the huts made of spruce brush, over which there was an occasional piece of cloth or canvas, or a caribou or moose skin. These brush houses were squalid affairs, and especially so compared with the bright, intelligent look of the makers, and with some of their other handicraft, as their canoes and wearing apparel. One could hardly stand up in the houses: they were generally double, facing each other, with a narrow aisle between, each one containing a single family, and about the area of a common government A tent. Fig. 6 gives a ground plan of a double brush house. The village of Kah-tung contained about twenty of these houses, huddled near the river-bank, and altogether was the largest Indian village we saw on the whole length of the Yukon River. There was a most decided Hebrew or Jewish cast of countenance among many of the Ayans; greater, in fact, than I have ever seen among any savages, and so conspicuous as to make it a subject of constant remark.

Fig. 7.—Kon-itl, chief of the Ayans.

Their household implements were of the most primitive type,—such as spoons of the horn of the mountain sheep, very similar to those of the T'linkits, but in no wise so well carved; and a few buckets, pans, and trays of birchbark, ingeniously constructed of one piece so as not to leak, and neatly sewed with long withes of trailing roots.

Just after landing the raft, the crowd that lined the narrow beach commenced singing and dancing,—the men on the (their) left, and the women on the right. The song was low and monotonous, but not unmusical,—characteristic of savage music. Their hands were placed on their hips, and they swayed laterally to the rude tune; while the medicine-men went through the most hideous gymnastics possible. A photograph was attempted of this group; but the weather was so unfavorable, the amateur apparatus so incomplete, and the favorable opportunity so hard to seize, that it was a complete failure. After tea and tobacco, which we could spare only in small quantities, fish-hooks seemed to be their favorite demand; and the very few articles they had to spare, mostly spoons and birch cups and buckets, were eagerly exchanged. Another article freely brought us was the pair of small bone gambling-tools, so characteristic of the whole north-west country. Fig. 8 is from a pair in my possession, and about true size. They are always used in pairs in gambling, one being distinguished from the other by one or two bands of black engraved around it. The game has been so often described that I will not repeat it. Their present village was evidently but a semi-permanent one, used only in summer during the time that salmon were running by; the pink sides of this fish, as they were hanging around, split open, forming a not unartistic contrast with the dark-green spruce boughs of the houses, especially if the nose was held between the two fingers. The women, instead of carrying the babes on their backs with their face to the front, turn them around so as to be back to back, and carry them so low that they fit somewhat in the

'hollow of the back.' The moose-arrows used by this tribe have a double barb forward, as in the common arrow, while one side is prolonged for two or three inches into a series of barbs; and these have the effect of working inward with the motion of the animal, if it be only wounded. In hunting moose, while these animals are crossing the streams or lakes, so one of my interpreters said who had traded among them many times, they do not hesitate to jump on the animal's back in the river, leaving the canoe to look after itself, and despatch the brute with a hand-knife. Of course, a companion is needed in a canoe to get the carcass ashore, and secure the captor's canoe.

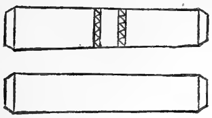


FIG. 8.

Small black flies were now commencing to be annoyingly numerous, and were added to the plague of mosquitoes, that never left us. The bars, that were some protection from the latter, were of no use against the former. Nearly directly opposite the village the perpendicular bluffs shown in the first illustration ceased; and from here on, the hills on both sides of the river commenced to grow higher and even mountainous in character. About thirty-four miles beyond the Selkirk a very conspicuous mountain stream came in from the south, which I named after Prof. A. R. C. Selwyn of Ottawa. The river was still very full of islands, however, many of which are covered with tall spruce, and look very picturesque in the almost cañon-like river-bottom, the steep hillsides being nearly barren of such heavy timber. At this time our attention was called to a singular phenomenon, while riding on the raft, and especially noticeable on quiet, sunny days. I refer to a very conspicuous crackling sound, which was not unlike that of fire running through cedar-brush, and which the men attributed to a pelting on the raft from underneath by a shower of pebbles brought up by the swift current, and which would have been a good-enough theory as far as the sound was concerned; but measurements in these places invariably revealed no bottom for a sixteen-foot sounding-pole, and, when going over shallower and swifter water with pebbly bottoms, the crackling ceased. It being always in deep water of a boiling nature, figuratively speaking, I attempted to account for it in a manner explained by fig. 9. The raft x, drifting with the arrow, passes from a shallow to a deep stretch of water. The Yukon is very swift (we drifted that day, July 16, forty-seven and a half geographical miles in eleven hours and fifty minutes), and the pebbles, carried forward over the shallow part, and reaching a, are carried forward and literally *dropped* on a gravel-bank at some point forward, as b; and, water being a good conductor of sound, a person on a floating craft, during quiet days, would distinctly hear this falling, when it would not be heard if they were simply rolling along the bottom in swifter water. The suddenness with which the crackling commenced, and the gradual manner in which it slowly died out, also help this idea. A series of soundings before and after these sounds would have settled this theory; but it occurred so seldom (once or twice, or possibly three times, a day in this part of the river), that it was impossible to foretell it so as to do so, unless one kept sounding all day. It was noticed in a much less degree on the lower river, but probably would not have been observed if previous experience, of a

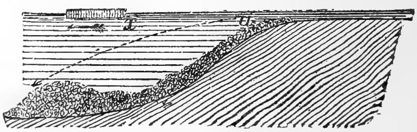


FIG. 9.

more marked character, had not brought it before us. Some twenty or twenty-five miles below the Ayan town, we saw a large black bear about halfway up the hillsides of three thousand feet altitude, and, not far from this, three mountain goats near the summit. A number of Ayan graves were seen on the banks of the river, resembling, in general, the one photographed at Selkirk.

(*To be continued.*)

DEVELOPMENT OF SIPUNCULUS NUDUS.

DR. HATSCHEK adds to the list of his valuable embryological memoirs a very elaborate and interesting paper on the development of the gephyrean, Sipunculus nudus.

The cleavage is unequal, and results in the formation of about twenty-four cells, of which *seven* form the endoderm, and *seventeen* the ectoderm. The endodermal cells are arranged in three pairs on the lower pole of the egg, with an odd cell at the hind end. This stage corresponds to a blastula with a single wall of cells enclosing a cleavage-cavity. The odd endodermal cell is the mother-cell of the mesoderm, and is called the 'primary mesoderm cell' in the following stages. An invaginate gastrula is formed; and during this stage the primary mesoderm cell divides, thus giving a pair of mesoblasts at the

posterior border of the blastopore. During the closure of the blastopore, which begins at the hind border and progresses towards the anterior border, the pair of mesoderm cells pass inward, taking up a position between the ectoderm and the endoderm. The blastopore closes completely; but the last (anterior) portion to close corresponds in position with the inner opening of the oesophagus, which is an ectodermal invagination.

Almost as soon as the gastrulation begins, the ectoderm becomes clothed with cilia, which pass through the pores of the zona radiata, and are thus in a position to set the embryo, together with its envelope, in motion.

One of the most interesting features of the development is the formation of an embryonic envelope at the expense of the ectoderm, only a portion of the ectoderm entering into the embryo proper. The ectodermal parts of the embryo arise from two separate portions of the ectoderm; viz., (1) a group of cells at the animal pole, and (2) the ectoderm cells of the blastoporic rim. The former, called the 'head-plate,' bears a long tuft of cilia, and later gives rise to the supra-oesophageal ganglion: the latter, called the 'trunk-plate,' forms the body, including the oral and post-oral region of the head. The rest of the ectoderm is employed in forming the embryonic envelope, or serosa, which arises as a fold around the trunk-plate during the closing of the blastopore. The fold gradually closes up over the plate, and thus brings about conditions similar to those seen in insects. The inner layer of the fold, however, does not form an amnion, but is gradually absorbed in the trunk-plate. The head-plate stretches a short distance under the serosa, but is not completely enveloped. During the closure of the blastopore, the mesoblastic bands begin to form as two rows of cells budded off from the two mesoblasts, henceforth called 'pole cells of the mesoderm.'

Very early in the gastrula stage a circular groove forms around the head-plate, thus forming a boundary-line between the plate and the serosa. This groove is formed by the retreating of the protoplasm of the cells in this region from the egg-membrane. In the same manner is formed a dorsal canal, leading out of the ring-canal, and stretching along the dorsal side, terminating in the free edge of the fold around the trunk-plate. As this fold closes up over the trunk-plate, and its inner layer is gradually taken up by the plate, there is formed a cavity between the plate and the outer layer of the fold, or the serosa. The ring-canal, the dorsal canal, and this cavity, form together a system of amniotic cavities.

The main axis of the gastrula, which joins the animal with the vegetative pole, does not coincide with the long axis of the larva. The animal pole of the gastrula axis corresponds to the anterior pole of the larva, but the vegetative pole is carried forward on the ventral side to a point about midway between the mouth and the hind end; and this bending of the gastrula axis brings the 'pole cells of the mesoderm' exactly opposite the animal pole, at the posterior extremity of the larva. This change in axial relations is brought about by the growth of the trunk-petal. That part of this plate which lies behind the pole cells shifts its position to the dorsal side, and thus pushes the pole cells forward. The extension of the trunk-plate on the dorsal side is soon followed by expansion on the ventral side. This growth of the trunk-plate not only changes the axial relations, but also brings it into continuity with the head-plate, thus effecting a union of the two hitherto separate ectodermal portions of the embryo.

The fully-formed embryo has a post-oral, ciliated band in the equatorial zone, close behind the mouth, and is attached to the egg-membrane and the serosa at the cephalic end. The escape of the embryo from the egg-membrane and the serosa requires several hours, and is attended with changes of the external form, especially in the region of the head-plate, that are not easily described without the aid of figures. It is the hind end of the body that first breaks through the envelopes. The rupture is made at the pole opposite the head-plate, and gradually increases in size as the body elongates, and forces its way outward. While the body is thus liberated, the head-plate is pulled away from the serosa and the membrane, but remains fastened at several points by string-like elongations of its substance. The serosa and membrane now form a sort of helmet, which the embryo bears about for some hours, and then throws off.

Only two days and a half are consumed in the embryonic development, while the larval period, upon which the embryo now enters, and during which it leads a pelagic life, continues for an entire month. During this period the larva grows rapidly, without undergoing any important changes in form or in inner organization, except the formation of the ventral nerve-cord and the histological differentiation of the muscles.

At the end of this period the larva is changed by a quick metamorphosis into the adult form. The metamorphosis is characterized by the loss of the ciliated band, the degeneration of the accessory organs of the oesophagus, the narrowing of the stomach, and the acquisition of the dorsal vessel. These changes seem to be correlated with the abandonment of a free pelagic life. The rapid growth does not take place uniformly in all parts, but most energetically at the hind end of the body. This 'polarity of growth' is characteristic of metameric and many non-metameric animals.

At the beginning of the larval period no part of the nerve system is fully differentiated. During this period the ventral nerve-cord arises, not by the concrescence of symmetrical halves, but as a single median thickening of the ectoderm. The development and separation of this cord from the epithelium progresses from the anterior end of the body backward. The oesophageal commissures form later than the ventral cord; and their development progresses in the opposite direction, beginning at the anterior end of the cord, and advancing towards the head-plate. Last of all arises the supra-oesophageal ganglion from the deeper cells of the head-plate, which bears the two pigment eye-spots. The com-

missures begin as a single string, which forks anteriorly to form the oesophageal ring.

The muscular sack consists of an outer ring-muscle layer and an inner layer of longitudinal fibres.

The blood-vessel system belongs to the latest formations. The dorsal vessel has, for the most part, an asymmetrical position, beginning on the dorsal side of the oesophagus, and running along the left side of the alimentary canal, to end in the region of the dorsally placed anus.

During the metamorphosis the nephridial organs undergo a rapid transformation; the cilia and ciliated funnels disappearing, and the looped portions being reduced to vesicles.

In conclusion, Hatschek discusses the phylogenetic relationship of Sipunculus nudus with Phascolosoma and the annelids. Sipunculus agrees with the annelids in the formation of the germ-lamellae and the gastrula, in the origin of the mesoderm from two primary mesoblasts, in the splitting of the mesoblastic bands into a visceral and a parietal leaf, in the closure of the blastopore, and in the formation of the oesophagus at the point which marks the last portion of the blastopore to close, but differs in having an embryonic envelope, and especially in the absence of any trace of metamerism.

The larva has some characters in common with the Trochophora, which plays so important a *rôle* in the worms and mollusks; but these are such as are generally preserved, even after the Trochophora stage is passed. The points of agreement are, an ectoblastic stomodaeum and proctodaeum and entoblastic mesenteron, and the head-plate (*scheitelplatte*): the points of difference are, absence of a pre-oral ciliated band, weak development of the head in comparison with the body, the possession of a secondary body-cavity (*coelom*), and the absence of provisional head-kidneys and head-muscles.

The absence of any sign of metamerism forms the most important objection to the derivation of the Sipunculidae from the annelids.

Hatschek concludes that the class Gephyrea must be broken up, the Echiuridea forming a sub-order of the chaetopods, and the Sipunculidae allowed to stand in the place hitherto occupied by the Gephyrea, i.e., next to the annelid class. C. O. WHITMAN.

THE MEETING OF THE AMERICAN MEDICAL ASSOCIATION IN WASHINGTON.

THE thirty-fifth annual session of the American medical association was held in Washington, D.C., early in May, beginning on the 6th, and closing on the morning of the 9th.

The mornings were devoted to the transaction of routine business by the general association; and the afternoons, to the meetings of the different sections, the reading of papers, and the discussions resulting therefrom.

The attendance of delegates was very large, the number registered exceeding thirteen hundred. The interest in the exercises was great, and the amount of work done may be favorably compared with that of any previous meeting of the association. A detailed criticism of the individual papers presented, or of the work done in preparation for them, would be out of place and impossible. The several authors will have full justice in the columns of the *Journal* of the association. A review of the meeting as a whole may be of interest, however, together with a consideration of some of the more important incidents which may bear fruit that will affect the community at large.

The first thing that will bear criticism is the enormous amount of material that was placed upon the programme. In the section for the 'Practice of medicine,' etc., besides the leading paper of the first afternoon, there were eight others ready for presentation on the same day. Inasmuch as the session did not begin until 2.30 P.M., there was, of course, no possibility of doing justice to all this work. The possibility of *injustice*, however, was very great, not only in the shortening of the discussions, which should be the most important part of the work, and which should form the channel for the presentation of new or original work by those taking part, but also in the non-presentation of some of the papers at all. This latter point is to be deplored, for the reason that any one who has once put himself to the trouble of preparation, only to suffer disappointment, is not likely to repeat the experiment in the future. Thus, the society may be deprived of the pleasure and profit to be derived from listening to men who may have results of importance to communicate.

Another thing that should be put a stop to in the future, and this once for all, is the action of some of those who took part in the discussions, in reading from manuscript which could not, by the wildest stretch of the imagination, be considered as having been 'notes,' and which in many cases bore only the faintest relation to the subject in hand. An attempt in this way to present a paper where it had no business to be, was fortunately defeated on the afternoon of the third day of the meeting; but this was the only instance of a protest upon the spot that we know of. The invitation to take part in a discussion should be declined, if the recipient does not feel himself sufficiently well equipped to speak in any but this cut and dried fashion. The idea of a discussion, it should be needless to state, is to call out the individual opinions of participants, and not to afford an opportunity for the introduction of papers not on the programme.

A resolution urging the various medical schools of the country to adopt a higher standard for graduation was passed, and should be of interest to all who are concerned about the medical attendance upon their families. If this action should bear fruit, it alone would be enough for the association to have accomplished at one meeting. The loose manner in which so many of the schools of the country grant their diplomas, and the ill effects of such action, can only be fully appreciated by the medical profession itself. Every member of society, however, is, or

should be, interested in so vital a question. None of us know, fortunately perhaps, how, or at what time, the injury may come to us through the ignorance of some of the new-fledged graduates of many of our schools. It should be said again and again, therefore, that the diploma-giving power of many of the medical schools of this country should be in some way regulated according to the thoroughness of their course for a degree.

The movement to induce the International medical congress to hold its meeting of 1887 in this country should meet with the success it deserves. The possible benefits to be derived from this are very great and far-reaching. The presence of so many of the *savants* of the medical world might be of benefit in showing some of us what we do not know. The bringing so near home, too, the results of the scientific labors pursued so much farther abroad than they are with us, might serve to open the eyes of more of our rich men, and lead to the establishment of the scientific laboratories that we need so much.

A committee was appointed to attempt to induce congress to provide for the systematic investigation of infectious diseases in this country, — a forlorn hope truly, so long as our legislators are as they are; but at the same time the slight possibility of success should not hinder the attempt from being made. Those who are interested in scientific investigation of this nature, however, do not look for the establishment of any governmental institution until the average member of that government has lost his desire for a sure return in dollars and cents to an investment.

The lack of scientific work in its purest form was well shown in the discussion upon 'tuberculosis' which took place on the last day of the session. This disease is the centre of scientific medical interest just now, and has been ever since the announcement by Koch of his discovery that its cause could be found in a micro-organism. The evidence brought forward since that time has been strongly in support of the truth of his assertions. The gentleman who opened the discussion did not agree with Koch's conclusions on the ground of personal observations; the basis of his conclusions being reserved, however, for future publication. By far the larger number of those participating in the discussion took sides with Koch; and yet, eminent as most of them were, there was hardly an observation made that was based upon the result of original personal investigation. For this reason the discussion was satisfactory only as bringing out personal opinion as based upon literary, and not upon laboratory work. What is needed in this country, above and beyond any thing else in the medical way, is a corps of scientific investigators devoted to their work, and thoroughly well equipped by temperament and training. Before this comes, however, must be the establishment of thoroughly endowed and completely independent centres where their work can be performed.

This gathering in Washington should teach the impropriety of asking for papers that are not likely to be presented to the meeting, the necessity for a little more control over the methods of discussion, and the need for a better representation of the men especially interested in scientific research, if there be any who have not yet made their appearance.

The needs especially emphasized are the want of a higher standard of medical education throughout the country, and particularly the lack of facilities for scientific research in the newer branches of medicine.

From a professional point of view, the meeting was a successful one in most respects; the papers that were presented showed care in preparation, and, as a rule, a thorough practical knowledge of the subjects treated. As in all such cases, however, the especial benefit to be derived was found in the opportunities presented for personal contact and conversation between men separated by long distances from one another.

HOW EGG-COCOONS ARE MADE BY A LYCOSA.

AT the meeting of the Academy of natural sciences of Philadelphia, May 13, Rev. Dr. H. C. McCook stated, that, while walking in the suburbs of Philadelphia lately, he had found under a stone a female Lycosa, probably L. riparia Hentz, which he placed in a jar partly filled with dry earth. For two days the spider remained on the surface of the soil, nearly inactive. The earth was then moistened, whereupon she immediately began to dig, continuing until she had made a cavity about one inch in depth. The top was then carefully covered over with a tolerably closely woven sheet of white spinning-work, so that the spider was entirely shut in. This cavity was fortunately made against the glass side of the jar, and the movements of the inmate were thus exposed to view. Shortly after the cave was covered, the spider was seen working upon a circular cushion of beautiful white silk about three-fourths of an inch in diameter, which was spun upward in a nearly perpendicular position against the earthen wall of the cave. The cushion looked so much like the cocoon of the common tube-weaver, Agalena naevia, and the whole operations of the lycosid were so like those of that species when cocooning, that it was momentarily supposed that a mistake in determination had been made. After the lapse of half an hour, it was found that the spider had oviposited against the central part of the cushion, and was then engaged in enclosing the hemispherical egg-mass with a silken envelope. The mode of spinning was as follows: the feet clasped the circumference of the cushion, and the body of the animal was slowly revolved; the abdomen, now greatly reduced in size by the extrusion of the eggs, was lifted up, thus drawing short loops of silk from the expanded spinnerets, which, when the abdomen was dropped again, contracted, and left a flossy curl of silk at the point of attachment. The abdomen was also swayed backward and forward, the filaments from the spinnerets following the motion as the spider turned, and thus an even thickness of silk was laid upon the eggs. The

same behavior marked the spinning of the cushion, in the middle of which the eggs had been deposited. The ideas of the observer as to the cocooning habits of Lycosa were very much confused by an observation so opposed to the universal experience. Upon resuming the study after the lapse of an hour and a half, he was once more assured of being right by the sight of a round silken ball dangling from the apex of the spider's abdomen, held fast by a short thread to the spinnerets. The cushion, however, had disappeared. The mystery, as it had seemed, was solved: the lycosid, after having placed her eggs in the centre of the silken cushion, and covered them over, had gathered up the edges, and so united and rolled them as to make the normal globular cocoon of her genus, which she at once tucked under her abdomen in the usual way. This was a most interesting observation, which Dr. McCook believed had not before been made. The manner of fabrication of the cocoon of Lycosa had been heretofore unknown to him, and, by reason of her subterranean habit, the opportunity to observe it was of rare occurrence. He had often wondered how the round egg-ball was put together, and the mechanical ingenuity and simplicity of the method were now apparent. The period consumed in the whole act of cocooning was less than four hours: the act of ovipositing took less than half an hour. Shortly after the egg-sac was finished, the mother cut her way out of the silken cover. She had evidently thus secluded herself for the purpose of spinning her cocoon.

Dr. McCook also alluded to another interesting fact in the life-history of the Lycosa, which had been brought to his attention by Mr. Alan Gentry. A slab of ice having been cut from the frozen surface of a pond about eight or ten feet from the bank, several spiders were observed running about in the water. They were passing underneath the surface, between certain water-plants. It is remarkable to find these creatures thus living in full health and activity, in midwinter, within the waters of a frozen pond, and so far from the bank, in which the burrows of their congeners are commonly found. It has been believed heretofore, and doubtless it is generally true, that the lycosids winter in deep burrows in the ground, sealed up tightly to maintain a higher temperature.

CALDERWOOD'S MIND AND BRAIN.

The relations of mind and brain. By HENRY CALDERWOOD, LL.D., professor of moral philosophy, University of Edinburgh. Second edition. London, *Macmillan & Co.*, 1884. 20 + 527 p. 8°.

IT is a striking comment upon the complete change of stand-point assumed by psychologists, to find an eminent Scotch metaphysician giving up one-half of a work upon the mind to the consideration of the anatomy and physiology of the brain. That he is in accord with the prevailing tone of thought, both among general readers and among special students, is proved by the fact that a second edition of this work has been demanded.

Dr. Calderwood presents the results of recent investigation in two sciences, — physiology and psychology, both animal and human; and his work is in the main successful, because the author possesses the power of impartial judgment, which enables him to admit all the evidence before pronouncing a decision, and also the power of making a clear statement of both scientific facts and philosophical problems. Those who desire to ascertain the kind of work which is being done in the comparatively new department of physiological psychology will find the book of great service. The subject "has to do with the foundation questions for all mental philosophy; for current theories concerning the origin and development of life on the earth, and speculation affecting the order and government of the universe as a whole, have more or less bearing upon it" (p. 9).

In the earlier chapters, the author succeeds in giving a clear and interesting account of a dry and complex subject, — the comparative anatomy of the nervous system. He then proceeds to the physiology of its various parts, devoting particular attention to the question of the localization of functions in the brain. The existence of definite areas upon the surface of the brain, whose irritation produces motion of the limbs, or sensations, according to the area irritated, and whose destruction produces a loss of the power of motion or sensation in the corresponding organs, is no longer a matter of question. By confining his attention to the researches of Ferrier, and by omitting the equally important and more recent conclusions of Munk of Berlin, Dr. Calderwood has failed to give a complete review of the physiological facts at present known. Had he ascertained the position reached by pathologists from the study of cases of limited centres of disease in the brain of man, he would have admitted more freely the existence of localizable areas in the human cerebrum. In his chapter on brain-disorders, he omits to mention a large class of cases which have a bearing on this subject; viz., cases in which a small destruction of brain-substance has been accompanied by a loss of one function, the function affected depending upon the situation of the disease. In this connection, Dr. Calderwood repeats a statement of Sir Charles Bell, that "whole masses of brain in man may be destroyed without any immediate influence upon mind" (p. 51). As a matter of fact, careful examination of such cases will rarely fail to demonstrate the pres-

ence of mental symptoms, which may be summarized as a loss of self-control and consequent change of character. In spite of these defects, the author's statement of the subject of localization is the best that can be found outside of physiological text-books.

In an interesting chapter upon the comparison of structure and functions of the brains of various animals, the conclusion is reached that mental activity is not proportionate to complexity of brain-development. He says, "The state of the case is this: the dog, with a brain less elaborate in its convolutions, shows a higher degree of intelligence; the horse, with a more ample and complicated series of foldings in the convolutions, shows less intelligence. Advance in intelligence, and advance in complexity of brain-structure, do not keep pace with each other" (p. 148). He claims, on the other hand, that "large development of brain, apart from marked development of sensory apparatus, is prominently connected with the functions of the motor side of the nerve system" (p. 259). These conclusions serve to introduce his theory of animal intelligence, which is the new feature of this edition.

Animal intelligence, according to Dr. Calderwood, is simply 'sensori-motor activity.' It is reflex and automatic action. It is the same in kind, from the simple act of the mollusk in drawing in and expelling currents of water, up to many of the most highly complex and coordinated acts of man. The nerve system, in all cases, may be resolved into a typical form, consisting of two sets of fibres (one sensory, one motor) meeting in a central organ, which may be a single cell of the spinal cord, or a complex assemblage of bodies crowned by the cerebrum. Motion starting at the periphery, carried along the sensory nerve, is communicated to the nerve-centre, there modified, and thence transmitted along the motor fibres, outward to the muscle, where it produces motion. This is sensori-motor activity. It is discriminative and purposive. But from these characteristics it is a mistake to argue intelligence. "Purposive action nowhere necessarily involves intelligence" (p. 205). The intelligence of animals, thus viewed, is the antithesis of intelligence in man, which has other characteristics. The degree of intelligence in animals depends upon the degree of perfection in their sensory organs. The great intelligence of the ant is due to its fine organ of touch, in the antennae; that of the chick, to its power of vision; that of the dog, to its keen sense of smell, combined with its moderately developed sense of sight, etc. He concludes, that, in the whole range of animal life, power of discrimination is largely determined by the range of sensibility belonging to external organs of sense. "The so-called intelligence of animals is nothing more than the purposive action of mechanical apparatus." Their memory is mechanical, and does not imply true intelligence, as Huxley has long taught. The degree of intelligence in animals is due less to the development of inherent powers by natural selection than to their training by man. "The intelligence of the dog is a distinct product of thousands of years of human training. . . . Accordingly the intelligence of the dog is withdrawn from available evidence as to natural evolution of intelligence in the world. . . . This is not intended as a denial of a law of evolution operating within living organism, but it materially affects the structure of the theory of evolution by natural selection, taken as a whole" (pp. 250, 251). "Evolution of organism and of intelligence do not so harmonize that progress in the one can be a pure index to progress in the other" (p. 261). From the study of animal actions, Dr. Calderwood concludes that no animal interprets its own sensory experience, or develops its own nature, or improves that of its own species, by reflective exercise. "All that is concerned with higher intelligence, whose natural function it is to seek the interpretation of sensory impressions, and to govern activity on principles of conduct superior to the impulses of sensory apparatus, lies quite beyond the region of investigation hitherto explored. . . . Mind does not find a place within the area of nerve apparatus" (p. 288). Mind is revealed to us by consciousness. "Consciousness assures us of the existence of non-organic elements connected with sensory experience: viz., 1°, interpretation of impressions made on the sensory apparatus; 2°, inference by comparison of past experience with present; 3°, synthesis of knowledge by use of forms and materials belonging to mind itself. . . . These indicate the presence in human life of an intelligent nature distinct from organism, as it is different from that which we designate 'animal intelligence'" (p. 308).

This view of the subject deserves consideration, however much we may differ from the author. It is evident that Dr. Calderwood believes that there is no relation between brain and mind as he defines the latter. But being unable to ignore the resemblance between the intelligent action of animals and of man, or to pass by the many forms of interaction of mind and body as described in a subsequent

chapter, he adopts the automatic theory for the explanation of animal intelligence, and carries it farther into the range of human action than any psychologist has hitherto ventured to do.

His theory of the dependence of mental activity upon the degree of perfection of sensory organs in animals is ingenious, but his own statement of the typical form and function of the sensori-motor system is opposed to it. That system is a double one, and no amount of development in one half can compensate for a lack of development in the other half. However fine the structure of a sensory organ, it is useless, unless a corresponding development has occurred in its governing centre and executive motor apparatus. An example in point is the olfactory apparatus in man, which is a beautiful piece of mechanism, without a correspondingly complex central organ, — a survival of a formerly valuable sense, at present almost useless. Nor can Dr. Calderwood's conclusion that the complexity of brain structure is proportionate to muscular development be admitted in a causal connection. There is, doubtless, a parallelism. But the one settled fact of brain physiology is, that, through the entire range of vertebrate animals, but two convolutions of the brain are the seat of motor functions. The other convolutions have nothing to do with governing muscular action; and it is inconceivable that they have developed simply to keep pace with the two motor convolutions which form but a small fraction of the entire brain. From a comparison of the habits of the dog and the horse, and of the dog and the ape, Dr. Calderwood concludes that the dog is a more intelligent animal than the others. He finds the dog's brain a comparatively simple structure, and then states his wide generalization that complexity of structure has no relation to intelligence. But a few pages farther on he takes care to show that the dog's intelligence is due to a thousand years of man's training. Is it not possible that the horse and ape, under the same conditions, might have made even a greater progress than the dog has made? And as long as this possibility remains, does it not invalidate the generalization?

It is impossible, in a limited space, to follow the author in all his arguments. It is only necessary to call the attention of readers to the fact that Dr. Calderwood's explanations of the facts he so clearly states, are not the only ones to be considered. The chief defect in the entire discussion of animal intelligence is the lack of discrimination between various grades of reflex action. There are lower and higher reflexes, simple and complex reflexes, according as the reflex centre excited lies farther from or nearer to the cortex of the brain. Each higher reflex centre not only possesses a power of its own, but also exerts an inhibitory action upon those below it. It is this inhibitory action which makes reflex action purposive. A complex reflex centre receives numerous sensory impulses, compares them, and selects the proper response. If we admit that the cortex can act automatically, we must admit, that, in such automatic action there, the centres receive, group, distinguish, and co-ordinate many various impulses arriving in them from different organs at once, and respond by sending out a complex and co-ordinated impulse to the muscles. An example is the balancing of the somnambulist as he walks a narrow bridge. This is very different from the simpler reflex which draws back a finger from the flame. But when this complex reflex is analyzed, it is found to contain many of the elements which Dr. Calderwood would limit to conscious intelligence of man. In the anecdotes given on pp. 236 and 243 we have examples of a 'sensori-motor activity,' which was certainly the result of the animal's interpreting its own former sensory experience, and comparing past with present acts with a view to the regulation of conduct. In a word, we have in these animals' actions a proof of consciousness and intelligence in the strict sense in which the author applies these terms. 'Mind' must be given a place within the area of nerve apparatus. It may be admitted that we have no proof of the existence of consciousness in others; but, if we argue consciousness from action, we must include the actions of animals as well as of our friends. We are reduced to one of two alternatives: either much that Dr. Calderwood advances as evidence of mind in man is really evidence of a more complex sensori-motor activity, or much that he explains away in animals is true intelligence. There is such a continuity of development, both in organism and in intelligence, that any attempt to draw a boundary-line between sensori-motor activity and intelligence at once raises objections on both sides, — a conclusive proof that we are not yet able to draw the boundary.

We do not care to follow the author through the more psychological part of his work, as his explanations lose much of their force in view of these objections. It is gradually becoming evident that a rich field for cultivation in psychology lies, within the domain of

pathology; that the study of diseases of the brain throws much light upon normal mental processes. In a future edition we hope to find a more thorough investigation of the facts of pathology. Dr. Calderwood has made a distinct advance from the old position, which limited the study of psychology to the facts presented by self-consciousness. In this direction there is room for farther advance. The candor of the author, his critical acumen, and his freedom from irritation in stating or examining opposing views, fit him for the work he is doing in an eminent degree. His style is finished and attractive. The book, with its numerous illustrations, is pleasant reading, and will doubtless reach a third edition. It will be of interest and of service to those who, from lack of familiarity with German, are unable to read the superior work of Wundt, *Grundzüge der physiologischen-psychologie.*

THE GOVERNMENT AGRICULTURAL REPORT.

Report of the commissioner of agriculture for the year 1883. Washington, *Government printing-office,* 1883. 496 p., 11 pl. 8°.

THE present volume is the twenty-third, we believe, of a series eminently well qualified to excite the curiosity of a scientific inquirer. It must, in truth, be admitted that the volumes of this series are less peculiar, on the whole, than their immediate predecessors, the so-called agricultural portion of the old patent-office reports; but the new dispensation has been odd enough, and it will doubtless be freely commented upon by future historians on this account. Taking the volumes one with another, the investigator will find in them a considerable mass of 'statistics' at which he may well look askance; divers reports 'of divisions' or of specialists, of every conceivable grade of mediocrity, illumined at rare intervals by glints of sense or strength; while occasionally he will come across papers of real excellence. In addition to the official lucubrations, there has generally been published a considerable bulk of twaddle, pure and simple, obtained 'by favor of representative farmers,' and published, evidently, for the purpose of pleasing the writers. Such men are, in truth, representative specimens of the class which finds comfort and satisfaction on seeing its name in print. People of this sort have always hung like an incubus on the agricultural newspapers of the country, in spite of all the asphyxiative devices known to editors; but it is specially offensive to behold them emblazoned on the very escutcheon of the greatest nation on earth, — on the facet, namely, presented by one of the most conspicuous of the governmental establishments. It is but mild reproof to say that the department of agriculture has, from the beginning, kept well behind and below the standards of science and knowledge actually existent in the country. With regard to the matter of statistics, it is gratifying as well as in some sort amusing, to be assured officially that they are now valuable. The commissioner says (p. 9), "The division of statistics has never done better work than in the past year. It has advanced its standing for accuracy and breadth in this and in foreign countries. *Its aim is in direct contrast with the prevalent haste and superficiality of the day, towards completeness and fulness of statement, a true parallelism in comparison, and legitimacy in deduction,*" — a sentiment so elevated that we are constrained to print it in italics.

So long as men are men, there will doubtless be found two opposing camps to debate the question of the barren fig-tree. There will be those to cry, 'How long, O Lord, how long?' and to pray for means of radical destruction; while others of sanguine mood, together with all those who find comfort and shelter in the shadow which the tree casts, will insist on the continuance of processes of manuring, watering, grafting, caprificating, tinkering, and cosseting, even to the end of time. Thanks to such fostering care, the department of agriculture continues to live its life; and it is but fair to say, that, for the year now in question, some of its twigs or branches do give evidence of a certain vigor and comeliness. The reports of the entomologists in particular, and of the veterinarians, are noteworthy and praiseworthy. Professor Riley's report shows, as usual, the hand of a master in all its parts. Some of the experimental work relating to the destruction of insects will be found interesting by not a few general readers, more especially the results of trials of emulsions of petroleum used as insecticides. The discovery that petroleum can be applied in this way is manifestly one of very great practical importance for farmers, gardeners, and vine-dressers. Professor Packard's report on the causes of destruction of evergreen forests in northern New England and New York is full of interest and instruction. It is an excellent example of the manner in which technical scientific reports should be written.

Dr. Salmon's report on the work and plans of the veterinarians is indicative of scientific

enlightenment and of high ambition. The tone, withal, of a good part of his report, is excellent. To follow in the footsteps of Pasteur and Koch in the study of contagious diseases, to popularize the results of these investigators, and to surpass their results when possible, are certainly aims worthy the aspiration of any man. But the sympathizing reader cannot avoid the thought, that, while anticipation must necessarily come before fulfilment, past history most distinctly teaches that high hopes of future deeds and glory are wholly out of place in the offices and laboratories of the American agricultural department. The methods of Pasteur not only require intelligence, experience, scrupulosity, and the peculiar knack or good judgment which constitutes the so-called gift for experimentation, but the experimenter must needs have composure of mind, and a sense of continuity; i.e., a reasonable certainty of furtherance and support from year to year, such as a connection with the department of agriculture is little calculated to give. One of the chief objects of Dr. Salmon is said to be to discover the best means of introducing and diffusing the European methods of inoculation for rendering fowl, cattle, sheep, and hogs, insusceptible to various contagious diseases. To an ordinary citizen it would have seemed manifest that the veterinary profession throughout the country must be a fitting vehicle, both for the conveyance of the necessary viruses, and the application of them. It would seem, too, as if the members of the veterinary profession, if anybody, would be keenly alive to the duty of procuring the needful 'attenuated virus,' even if the object had to be studied in European laboratories. Where such enormous money interests are at issue, and open, for that matter, for the remuneration of competent practitioners, it seems well-nigh incredible that the profession should idly await the action of a government official before advancing upon the common enemy with all the appliances of modern warfare. It is plain enough that the protection of domestic animals from contagious diseases is a subject which must necessarily become very prominent in this country in the near future; and time alone can tell how the doings of the unattached veterinary doctors will compare with those of their brethren in government employ. But assuredly there must be some misconception lurking in the minds of the department officials, if they really suppose that the veterinary profession is necessarily incompetent to deal with a problem because, forsooth, the known methods of solving it happen to be delicate and expensive. We would have argued, rather, that it would be distinctly discreditable to the profession in this country, unless it should be found foremost in applying known remedies of approved efficacy.

THE PANTHER-CREEK COAL-BASIN.

Second geological survey of Pennsylvania, A. A. First report of progress in the anthracite coal region. The geology of the Panther-Creek basin, or eastern end of the southern field. By CHARLES A. ASHBURNER. Harrisburg, *Survey*, 1883. 47+407 p., 7 pl. 8°.

THERE is evidently some divergence of opinion as to what is the proper scope of, and what the best method of conducting, a geological survey. All, undoubtedly, would admit, to the public at least, that its primary object is the development of the mineral resources of the region under survey. As to whether, for the accomplishment of this purpose, it is better to devote the main part of the work to those general questions which form the basis of all geological investigation, making the practical application of geology to economic ends a secondary matter, or whether, on the other hand, it is better to lay more stress upon the practical solution of the problems of most pressing economic importance, and let the facts which bear upon the general questions slowly accumulate, to be treated systematically later on, there is, however, less unanimity.

The second geological survey of Pennsylvania has apparently followed the latter system; and Mr. Ashburner's work in the anthracite regions is among the best specimens of this kind of work. In his prefatory letter he says, —

> "My principal object has been to make the results of the survey practically useful to those directly interested in the exploration and exploitation of the anthracite fields; and therefore the work in the field has been prosecuted under the constant review of those connected with or engaged in the mining of coal.
>
> "The policy of pushing the purely geological and mining work of the survey at the outset, in order that practical men might see some results, and be able to judge their utility, not only to themselves, but to all having interest in the anthracite region, has proved a wise one. The publication (in advance of the report) of 13 atlas sheets, accompanying this report, has already secured to the survey the support of every one in the region, from the miner engaged in cutting coal in the mines, to the presidents of coal transportation companies, all of whom were unanimous in urging the appropriation which was made by the legislature of 1883."

The maps themselves have already been referred to in this journal (vol. i, p. 309). The

present report is practically a series of explanatory sheets accompanying the maps, it being intended, after the survey of the entire region is completed, to publish two volumes summarizing the results, — one on descriptive, the other on systematic geology.

Besides the explanations of atlas sheets and sections, which will find ample criticism and verification at the hands of the multitude who will practically use them in the field, the volume contains some practical investigations into the character and composition of the different coals; the amount of coal already mined, and that which probably remains in the basin, not yet taken out; together with an elaborate description of the methods employed in preparing the various maps, and in obtaining these results.

In no scientific work is the personal equation of the observer so large as in geological investigation; and it would be well if all our geological workers felt as Mr. Ashburner does when he says, "In the case of a public survey, I believe that all the facts which are used in any investigation should be clearly stated, so that, from a personal examination of the subject by an expert, the results can be accepted with confidence, or can be rejected with reason."

In estimating the amount of commercial coal under a given area, Mr. Ashburner first develops each bed upon a horizontal plane, to obtain the actual area of the bed, and then calculates the average thickness of coal, not only from measured sections, but from practical results of shipment from different mines; he also wisely distinguishes the regular from the overturned dips, as the amount of marketable coal obtained from beds in the latter position is very much less than the average.

In comparing the thus calculated amount of coal originally contained in the Panther-Creek basin with the amount that has been taken out since the commencement of mining, in 1820, he finds that only twenty-seven per cent has been sent to market as fuel; while thirty-two went to the dirt-banks as refuse, and forty-one per cent was left in the mines for roof-supports, etc. A practical loss of seventy-three per cent of all the coal in a given bed seems much too large, and suggests wasteful methods of mining and preparing. That these have already been somewhat improved, is shown by the same figures for the years 1881 and 1882, when the percentages are respectively forty-six, twenty-four, and thirty, or a loss of only fifty-four per cent.

The fact that the analysis of bony coal taken from the dump of one of the collieries (p. 181) gives a higher percentage of fixed carbon, and less ash, than the analyses of coal sent to market from the same colliery, would seem to suggest one way in which present processes might still be improved.

Mr. Ashburner recognizes the insufficiency of present methods of the analysis of coal as a means of determining its relative value as a fuel, and it is to be hoped that his future investigations will result in some practical improvement in them. In a paper in this journal (No. 58), he has already pointed out to its readers that the previously received estimate of the percentage of fixed carbon in anthracite is too high.

At the close of the chapter containing the many vertical sections obtained of the coal series, showing the respective coal-beds in each, Mr. Ashburner remarks, that no attempt has been made to systematize them, and that he believes that it would be impossible to do so. He then proceeds to point out some of the many inconsistencies in the existing nomenclature of coal-beds, but fails to note the reason for these inconsistencies. They arise from the assumption that a given coal-bed is continuous over the entire area of a basin; whereas the fact is, that, while a certain series of rocks may be regarded as coal-bearing throughout the basin, individual coal-beds are of only limited continuous extent; the coal having been formed in small, interrupted areas, not in one broad, contemporaneous sheet over the whole area.

The appendix contains a paper by Mr. Arthur Winslow, on the use of stadia measurements in surveying. This very simple, and by no means new, substitute for chaining, is, Mr. Ashburner remarks, not generally used by surveyors in the region; but we doubt, from what we know of the average surveyor, if Mr. Winslow's use of the calculus in its discussion will add as much to its favor in their eyes as the few practical tests which follow.

MINOR BOOK NOTICES.

Logarithmisch-trigonometrische tafeln mit fünf decimalstellen. Bearbeitet von Prof. Dr. TH. ALBRECHT, Sectionschef im königlischen preussischen geodätischen institut. Stereotypausgabe. Berlin, 1884. 16+172 p. 8°.

IN *Science*, vol. ii. p. 174, the six-place tables of Dr. Albrecht were spoken of with the praise which they deserve. They will be found superior to any other six-place tables. It is harder to make an improvement in five-place tables, since we already have many excellent tables of this kind. But Dr. Albrecht

has made an improvement here, in the arrangement of the logarithms of numbers in single entry. The logarithmic sines and tangents are given for every second of arc up to 3° 0′ 0″; and the type of the main trigonometric table, together with its very convenient tables of proportional parts, makes this superior, on the whole, to any other similar one. A material improvement has also been introduced in the table of addition logarithms.

The formulae at the end are convenient, and not superfluous. They are elegantly arranged (see the black-faced type on p. 157, for example), and are such as are always needed. The table of constants, as in his six-place tables, is very full and most practical. A few electrical data might, perhaps, have replaced Gauss' formula for the date of Easter with advantage. This is, no doubt, the very best five-place table for general use, and exactly suited for use with students.

Topographical surveying. New York, *D. Van Nostrand*, 1884. (Van Nostrand science series, No. 72.) 210 p. 24°.

THE four papers which have been republished in this book, upon methods in surveying, more particularly adapted to topographical work, were first printed in *Van Nostrand's engineering magazine*. The one by George J. Specht explains the use of the stadia, with a telescope having additional horizontal wires, so that distances may be obtained without measurement. The application of photography to topographical surveying, as developed by the French engineers, so that the adjustment of two or more views of the same objects in a landscape to their proper positions on a sheet will enable these objects to be platted with their proper distances and elevations, is explained by Prof. A. S. Hardy. Applications of the geometry of position to some problems in surveying are given by John B. McMaster, — a method of solution which depends upon intersections of lines, and does not seem so convenient, expeditious, or accurate as other methods long and well known. The use of rectangular coordinates for the location and description of points is urged and illustrated by Henry F. Walling. All of these papers are necessarily brief, but serve to give some useful hints to the topographer. A more careful proof-reading would save a young surveyor from a little perplexity in knowing what is meant by some statements.

Dynamic electricity, including, 1°, Some points in electric lighting, by Dr. JOHN HOPKINSON; *2°, On the measurement of electricity for commercial purposes*, by JAMES N. SHOOLBRED; *3°, Electric-light arithmetic*, by R. E. DAY. New York, *Van Nostrand*, 1884. 4+167 p. 24°.

DR. HOPKINSON'S lecture before the Institution of civil engineers is an excellent treatment of the many analogies between the mechanical theory of electricity and the science of hydraulics. The student will find in this lecture a description of Maxwell's apparatus for illustrating the laws of induction, which has not found its way into any other treatise on electricity. A very pretty analogy between the action of the hydraulic ram and the extra current of induction is also given by Dr. Hopkinson. It is also shown how alternating dynamo machines can be run on the same circuit in order to assist each other, — a problem which has been considered by some unsolvable. The equations which illustrate the theory of the dynamo-electric engine are grouped together, and their practical use is shown. The author briefly refers to his improvements in the Edison dynamo, and gives an estimate of the cost of incandescent lighting. Dr. Hopkinson thinks that the efficiency of the carbon-filament lamp will be very much increased. These lamps have not been in the market more than three years, and it is reasonable to suppose that the coming three years will see great improvements in them. The prospect that the electrical incandescent light will be the light of the future seems a very good one.

The paper by Mr. Shoolbred gives an excellent account of the various meters invented by Edison, Sprague, Hopkinson, Boys, Ayrton and Perry, and others. Mr. Day's treatise on electric-light arithmetic is a useful one for the electrical engineer.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Division of chemistry. — Prof. F. W. Clarke is examining a collection of waters from the Virginia hot springs, and is also beginning a series of experiments upon the synthesis of silicates by the wet method. —— Dr. T. M. Chatard has completed a research upon a new method of estimation of alkalies in silicate analyses.

Dr. F. A. Gooch began work in the laboratory on the 2d of April, and since that time has been occupied almost exclusively with analyses of spring-deposits and rocks collected in the Yellowstone national park. He has completed analyses of waters from the Giantess geyser, and the Excelsior spring (or geyser), both in the park, and of a basalt from the same region, and a rhyolite from Washoe, Nev. —— Dr. Henry Erni also began work in April, and has been engaged in various mineral determinations of a qualitative character; notably, upon an alleged tin ore from Clay county, Ala., and phosphatic rocks and marls from Mississippi and Alabama.

The following analyses have also been made at the laboratory at Washington: galenite from near Washington; chlorite from Georgetown, D.C.; nephrite from Point Barrow, Alaska; margarite from Gainesville, Ga., and Iredell county, N.C.; copper ore from Lee's ferry, Arizona; fulgurite from Mount Thielson in Oregon; and water from Bear River in Utah. The latter was collected by Mr. I. C. Russell, and proves to be an ordinary river-water; the greatest impurity being carbonate of lime, of which there are contained .1080 of a gram to the litre, the total solid contents being .1845 of a gram to the litre. The fulgurite was collected by Mr. E. E. Hayden, and is being made the subject of special study by Mr. J. S. Diller. Some of the results of his examination will be given in a future number.

In the New-Haven laboratory, during March, Messrs. Barus and Hallock continued their high-temperature observations. Most of the work has been done with thermo-electric couples. The boiling-point of mercury has been redetermined with great accuracy. During April the boiling-point of zinc was the subject of study. It seems probable, from the present outlook, that these high-temperature researches will be very satisfactory in their results, and that they will render possible a wide range of investigations hitherto impracticable in the domain of physical geology.

In the laboratory at Denver, Mr. Hillebrand has been busy with the chemical examination of rocks from the Silver-Cliff district. He has proved the existence, at this locality, of several minerals not hitherto known to occur in North America. The results of his examinations also point to the existence, in one of these minerals, of silver in a very rare form, if, indeed, not in a combination hitherto unknown in the mineral kingdom. In March, eleven rock specimens were analyzed, and a number of interesting minerals from Ouray, Col. (some of them probably new to science), were examined.

In the laboratory at San Francisco, Dr. Melville was busy, in March and April, with routine work connected with Mr. Becker's investigations.

Paleontology. — Prof. O. C. Marsh, in April, had two field-parties at work in Jurassic beds in Wyoming Territory, and one in the Jurassic in Colorado. Although the weather was very unfavorable during a great part of the time, interesting results were obtained.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Engineers' club, Philadelphia.

May 17. — The secretary presented for Mr. Edward Parrish an illustrated account of the effect of sea-water on the iron of Brandywine shoal lighthouse. This lighthouse was built in 1849–50, near the mouth of the Delaware Bay, and stands in about six feet of water. It was the first screw-pile structure built in the United States, and had but few predecessors in the world. The house is supported on nine piles of hammered iron, surrounded by fifty-two piles of rolled iron, acting as an ice-fender. The whole is strengthened by systems of braces and ties. The effect of the water on the iron, continually submerged, has been to produce longitudinal seams or grooves, with occasional holes on the surface, in some cases seriously reducing the strength. The most extensive corrosion is observed on the hammered iron. Round rods in the air are altered in section, approximating an irregular polygon with longitudinal grooves. —— Prof. L. M. Haupt read a paper on rapid transit, giving valuable data relative to the effects of velocity of movement on the ratio of increase of population, and contrasting the situation in New York and Philadelphia. In comparing the topography of the two cities, a silhouette of Manhattan Island was laid on a map of Philadelphia (same scale), showing that the island, from the Battery to 150th Street (nine miles and a half), only extended from League Island to Erie Avenue. From this it was inferred, that, if there was need for elevated roads in New York, there was greater need for them in Philadelphia, "as the necessity is proportional to the extent of surface of a city, and the distance of its residents from the business centres." The former commercial supremacy of Philadelphia was considered, with the reasons for the rapid decline in the ratio of increase of population, which has diminished from seventy-nine per cent in the decade 1840–50, to twenty-five per cent for 1870–80; while Camden's population has increased from fifty-one per cent in 1850–60, to a hundred and eight per cent in 1870–80. In short, Philadelphia is overflowing because her time-limits of travel are too restricted. Assuming the time-limit at thirty minutes each way, or one hour per day, at the usual velocities of travel, the limits of the 'Pedestrian city' were found to be a square with diagonals of 4 miles, and area 8 square miles; 'Horse-car or cable city,' were found to be a square with diagonals of 6 miles, and area 18 square miles; 'Elevated railroad city,'

were found to be a square with diagonals of 12 miles, and area 72 square miles; 'Underground city,' were found to be a square with diagonals of 20 miles, and area 200 square miles. The total area of Philadelphia is 129 square miles, and, of the built-up portion, 13½, or ten and a half per cent. Deducting from the square representing the 'Street-car city' the salient intercepted by the Delaware River, it leaves just the same area, or 13½ square miles, showing the city to have reached the limit of street-car travel. The areas benefited vary as the squares of the velocity of travel: hence elevated roads would be worth to the city four times as much as surface lines, and underground roads about eleven times as much. Since 1850 Philadelphia has lost, in population, one-half a million people, equivalent to a revenue, on the real estate which they would have occupied and improved, of about two million dollars per annum. The two broad zones of the overcrowded portion of the city were also outlined; and the extent of the benefits to be conferred by only two lines of elevated roads were clearly shown, by diagrams, to extend to the entire city. Elevated roads occupy an intermediate position in cost of construction, rate of travel, and general utility, between surface and underground structures; and there can be no doubt that the time has fully arrived when this city, for her own sake, requires them, and should heartily co-operate with any parties so proposing to improve and extend her resources. The following were some of the conclusions arrived at: 1°. The city has reached and already surpassed the ordinary limits of street-car travel. 2°. The ratio of increase of population is rapidly declining, chiefly from lack of more rapid and cheaper means of transit. 3°. The present steam-roads in the city cannot supply the demand, as they have surface line trains, which must move slowly, and cannot be run at close intervals: fares are too high, and stations too distant. 4°. Camden, N.J., is rapidly gaining population at the expense of Philadelphia. 5°. The annual loss to the city in revenue, from the cause, will reach millions of dollars. 6°. Unless relief is afforded, the city will be corralled by time-limits, and the density of the population must increase rapidly at the expense of health and morality. 7°. Two lines of elevated railroads at right angles to each other, and properly located, would benefit an area equal to double that of the built-up portion of the city. 8°. The fears of opponents of elevated roads, of losses to the city or the individual from withdrawal of patronage or depreciation of property, are shown by experience in New York to be groundless. 9°. If Philadelphia desires to retain even the present low rate of increase in population, and high rate of salubrity, she must promptly respond favorably to the request of her citizens to be permitted to build elevated roads. 10°. The limits of the city are not such as to warrant any corporation in building an underground road, were it recommended or allowed, with any fair prospect of returns for many years. —— Mr. William H. Ridgway read a paper upon the action of water in the modern turbine, claiming that it is nothing more than an improved Barker's mill, and that there is no such thing as the water spurting through the shutes, and impinging on the buckets, as is generally believed; the wheel, on the contrary, taking a velocity very much greater than that of the inflowing water. —— Mr. J. J. de Kinder presented an illustrated description of a method of removing condemned machinery by dynamite, as practised by him in the case of the side-levers of the old Cornish pumping-engine at Spring Garden water-works, Philadelphia, which weighed twenty-nine thousand pounds each. Drilling, tapping, and breaking each beam in two, with half a pound of dynamite, and without injury to the building or other machinery, occupied thirteen hours. Even had despatch been unnecessary, it might have taken two weeks to do this work by the ordinary methods.

Academy of natural sciences, Philadelphia.

Botanical section, May 12.— Mr. Thomas Meehan referred to his theory that a fasciated branch is due, not to 'over-luxuriance' of life, but to a degradation of vital power, as published before the American association in 1870. A number of phenomena, conceded to result from low vital conditions, were considered by him to be inseparably connected with fasciation, the essential feature of which is the production of an extraordinary number of buds, with a corresponding suppression of the normal internodal spaces. This is precisely the condition of a flowering branch; and all its attendant phenomena find their analogue in a fasciated stem. Taking the test of vital power as the ability to retain life under equal circumstances, we find the leaves on a fasciated branch dying before those on the rest of the tree. In severe winters the branches in the fasciation wholly die in many cases, while those on other portions of the tree survive. Precisely the same circumstances attend inflorescence. The leaves, in their procession from a normal condition to petals, lose this evidence of vitality in proportion to the degree of transformation. The petal dies before the sepal, the sepal before the bract, and the bract before the leaves, in the general order of anthesis in a compound flower; though there are cases, where, secondary causes coming into play, this rule may be reversed. In a general way, however, the soundness of the point would not be disputed. From all these facts in analogy, it might be said that a fasciated branch is an imperfect and precocious attempt to enter on the flowering or reproductive stage.

Natural science association, Staten Island.

May 10. — Mr. Hollick read a paper upon recent discoveries of Indian implements at Tottenville, describing in detail the net-sinkers and hammerstones. These latter, according to Mr. Rau, were employed as hammers, "since they show the most distinct traces of violent contact with hard substances." The Tottenville hammerstones, with two exceptions, are made of soft sandstone, evidently with no intention of using them upon any hard substance; and there seems to be no doubt that in this locality they were used in cracking the oysters among whose shells they are so

plentifully found. Muncy, Penn., where Mr. Rau found his specimens, is on the banks of the Susquehanna, and no doubt shell-fish were caught and eaten there as at Tottenville; but this explanation of the use of the hammerstones does not seem to be insisted upon by him. The Tottenville specimens are made of such soft stone that one can hardly imagine any other use to which they could be put. The number of net-sinkers in use must have been immense, as even at the present time, upon the surface of the ground, they may be picked up in considerable number. One day, in about half an hour, fourteen were found. The extent of these shell-heaps can only be computed in acres. —— Mr. George F. Kunz of New York presented a stone head found near Clifton, Staten Island, about two hundred feet east of the railroad just above the Fingerboard Road, in a low swamp filled with the roots of the swamp-oak. A rustic-basket worker, named James Clark, came upon the stone head while digging up the roots of a high huckleberry-bush, at least ten years of age, growing at the edge of the swamp. The soil is a compact, light creamy brown, sandy clay, in which a stone like this could be buried for an age without much disintegration. When striking in his pick, at a depth of from twelve to eighteen inches, he turned up the head, his pick striking and indenting the chin. The material of which it was formed is a brown sandstone, apparently more compact than the common New-Jersey sandstone, and composed almost entirely of grains of quartz, with an occasional small pebble. The weight of the head is about eight pounds, its height seven inches, and it measures four inches through the cheeks, six inches from the tip of the nose through to the back of the head, and an inch and seven-eighths across the nostrils. The eyes are an inch and a quarter long, and five-eighths of an inch wide; they are raised in the centres, and have a groove running around close to the lids. A round hole a fifth of an inch deep had been drilled in the lower part of the nose, in the space between the two nostrils, evidently designed for a nose ornament, and both nostrils were hollowed out. The cheeks, in their lower part, are sunken in a very curious manner, causing the cheek-bones to stand up very high. The forehead is low, and retreats at an angle of sixty degrees. A trace of what had been or was to be the ear is perceptible on the right side. The back and upper parts of the head are almost entirely rough and unworked, as if it had never been finished, or was originally a part of some figure. The surface is rough and slightly weathered; the cheeks, forehead, and chin having single grains of sand apparently raised above the surface, as if by age and exposure. The discoverer, in cleaning it, had scraped the eyes and beneath the nose with a nail, and his shovel had formed a groove in one of the cheeks, — all of which scratches or marks have a very different appearance from the general surface, and are plainly recent. The style is Mexican, or still more resembles Aztec work.

Minnesota academy of natural sciences, Minneapolis.

May 6. — Mr. Warren Upham described three remarkable chains or series of lakes observed in Martin county, Minn., during his examination of that region as assistant on the state geological survey. These are familiarly known as the east, central, and west chains of lakes. The east chain extends twelve miles from north to south, and includes nine lakes, which vary from a half-mile to two miles in length. About five miles farther west, the central chain of lakes, parallel with the foregoing, reaches about twenty miles in an almost perfectly straight north to south course, including nineteen lakes of similar size with those of the east chain. The west chain is some thirty-five miles long, and is made up of about thirty lakes. Its course is south-south-east, beginning at Mountain Lake in Cottonwood county, and extending to Tuttle's Lake on the line between Martin county and Iowa. The surface of this region is everywhere a prairie of unmodified glacial drift or till, with no considerable deposits of gravel and sand. Its contour is moderately undulating, averaging twenty-five to forty feet above the lakes, the shores of which rise to this height in steep banks or bluffs. No other lakes arranged in such series have been observed, either in this state or elsewhere. The explanation of their origin which seems most probable is, that they mark interglacial avenues of drainage, occupying portions of valleys that were excavated in the till, after ice had long covered this region, and had deposited most of the drift-sheet, but before the last glacial epoch, which again enveloped this area beneath a lobe of the continental glacier, partially filling these valleys, and leaving along their courses the present chains of lakes. —— Mr. Upham also briefly described the belts of knolly and hilly drift, which have been traced through Minnesota by the geological survey. Nearly all of these belts are believed to be terminal or marginal moraines, accumulated along the boundaries of the ice-sheet of the last glacial epoch, as moraines are formed at the end and along the sides of alpine glaciers. The outermost morainic belt, running in a looped course across Wisconsin, Minnesota, Iowa, and Dakota, marks the farthest limits of this ice; and other belts of such drift accumulations, found at various distances back from this, mark stages where the ice halted in its departure. These drift hills and knolls are finely developed on the Coteau des Prairies, in south-western Minnesota and eastern Dakota, as also on the Coteau du Missouri, farther west. They surround Lake Minnetonka, and reach to the west edge of Minneapolis; they are also seen between this city and St. Paul, and east and north of St. Paul: indeed, they cover a considerable fraction of the whole state. From Lake Minnetonka a broad belt of morainic drift stretches a hundred and twenty-five miles north-west to the Leaf Hills, where the most massive development of this formation within the state is found, its highest elevations being from one hundred to three hundred and fifty feet above the general level. The outermost belt of these drift-hills has been named the Altamont moraine. No less than ten other morainic belts are distinguishable in Minnesota, showing successive stages in the recession of the ice-sheet. These moraines have been named from localities where they are conspicuously ex-

hibited, as follows, in their order from south to north: the Gary moraine, the Antelope, Kiester, Elysian, Waconia, Dovre, Fergus Falls, Leaf Hills, Itasca, and Mesabi moraines. The last of these crosses the northern part of the state, from the head waters of the Mississippi River, to Grand Portage on the north shore of Lake Superior. —— Mr. C. F. Sidmer gave some account of the manufacture of the Chamberlain illuminating-gas, made of petroleum, water, and air, and called attention to some of its advantages.

NOTES AND NEWS.

THE following is a complete list of the papers read to the scientific sections of the Royal society of Canada, at its recent meeting in Ottawa, of which an account is given elsewhere in this number:— In the physical section: F. N. Gisborne, Electrical induction in underground and aerial metallic conductors; C. Baillargé, A particular case of the hydraulic ram, or water-hammer; R. Steckel, The form of the contracted liquid vein, affecting the present theory of the science of hydraulics; T. Sterry Hunt, The origin of crystalline rocks; J. G. MacGregor, The density and the thermal expansion of aqueous solutions of sulphate of copper; E. Haanel, Blowpipe re-actions on plaster-of-paris tablets; Description of apparatus for distinguishing flame-coloring constituents when occurring together in an assay; T. E. Hamel, Essai sur la constitution atomique de la matière; N. F. Dupuis, The algebraical development of certain functions; E. J. Chapman, Contributions to our knowledge of the iron ores of Ontario; J. C. K. Laflamme, Note sur une fait météorologique particulier à Quebec. In the geological and biological section: A. R. C. Selwyn, Note of observations, in 1883, on the geology of a part of the north shore of Lake Superior; George Lawson, Revision of the Canadian Ranunculaceae; J. W. Dawson, Geology and geological work in the old world, in their relation to Canada; T. S. Hunt, The Taconic question in geology; W. Saunders, Note on the occurrence of certain butterflies in Canada; E. J. Chapman, Some deposits of titaniferous iron ore in the counties of Haliburton and Hastings (Ontario); Mimetism in inorganic nature; T. J. W. Burgess and J. Macoun, A monograph of Canadian ferns; L. W. Bailey, Geological contacts and ancient erosion in the Province of New Brunswick; G. F. Matthew, Illustrations of the fauna of the St. John group (part iii., Conocoryphidae, with notes on the Paradoxidae); G. M. Dawson, The glacial deposits in the neighborhood of the Bow and Belly Rivers; R. Bell, The geology and economic minerals of Hudson's Bay and northern Canada; J. C. K. Laflamme, Note sur certains dépôts aurifères de la Beance; Découverte de l'emeraude au Saguenay; J. F. Whiteaves, A description of a supposed new ammonite from the upper cretaceous rocks of Fort St. John on the Peace River; On a new decapod crustacean from the Pierre shales of Highwood River, N.W.T.; E. Gilpin, Notes on the manganese ores of Nova Scotia; D. Honeyman, A revision of the geology of Antigonish county, Nova Scotia; S. Obalski, Notes sur la constitution géologique de l'apatite Canadienne.

—It is to be hoped that there will be no lack of papers from chemists on this side of the Atlantic before Section B of the British association, and that the titles will be sent in as early as possible to Prof. H. E. Roscoe, president of Section B, British association, P.O. box 147, Montreal. The subjects for special discussion, as already announced, are, 1°, The constitution of the elements; 2°, Chemical changes in relation to micro-organisms. The first will be introduced by Professor Dewar, probably on Friday, Aug. 29; the second, by Professor Frankland, on Monday, Sept. 1.

— The land-office maps of the United States, and of certain of the states and territories, give a fair outline of our horizontal topography, with rough mountain shading, and, in addition to this, present various details — concerning public lands and land-offices; Indian, military, naval, and lighthouse reservations; railroad and large private grants, confirmed and unconfirmed — not to be found in our ordinary atlases. The latest edition, issued under the direction of Hon. N. C. McFarland, commissioner, includes the general map of the country, six and a half by four feet, dated 1883, on a scale of 40 miles to an inch; Alabama, 1882, 12 miles to an inch; Arizona, 1883, 15 miles; Colorado, 1881, 15 miles; Dakota, 1882, 18 miles; Florida, 1883, 12 miles; Idaho, 1883, 16 miles; Indian Territory, 1883, 12 miles; Louisiana, 1879, 14 miles; Minnesota, 1884, 15 miles; Montana, 1883, 18 miles; New Mexico, 1882, 16 miles; Utah, 1884, 15 miles; Washington, 1883, 15 miles; Wyoming, 1883, 15 miles. These state maps have the coasts, river-lines, townships, lettering, etc., in black; water-areas in blue; and reservations in red or green. Although we have to lament the lack of adequate representation of the relief of the land, the maps cannot be adversely criticised on account of this want; for the measurement of the vertical element of our topography has never been undertaken by the land-office: its work has been simply to measure off the public lands for sale, and to present such maps of the surveyed districts as shall serve to locate the various townships and sections. In the western mountainous region, the land-surveys follow only the lower country, and the adjacent mountains are merely roughly sketched; indeed, in some cases so roughly as to lose all of their characteristic form. But, on the other hand, some of the open country is shown in finer, or at least in *more*, detail than on any other maps yet published. Thus we find the lake districts of Florida and Minnesota well illustrated; and the number of lakes and ponds dotted over the plains of Colorado gives a clew to a peculiar chapter in their physical history. So, also, the branching and meandering of rivers in the Mississippi valley are drawn with greater variety of form, and hence, we may suppose, with a nearer approach to precision, than in our common atlases.

The post-office department also has a series of post-route maps, grouped in areas of several states together, and prepared especially for office use. The

latest edition consists of sixty-one sheets, dated 1884, with manuscript corrections to April 1, published by order of postmaster-general W. Q. Gresham, under the direction of C. Roeser, jun., topographer, post-office department. They are printed in black outline, on a scale varying from six to fifteen miles to an inch, with state and county boundaries tinted red, and show all cities, towns, and villages having post-offices, with many more besides; all post-routes, whether by rail, boat, or stage, with the distance between offices; and a conventional coloring to designate the frequency of the mail-service. Rivers and the larger streams and lakes are represented, but often without name; mountains are not shown, except on a few of the newer western sheets. Apart from their original use, these maps, therefore, serve simply as a basis for additional work, and are best adapted to studies of a statistical character.

— The new journal of astronomy, *Bulletin astronomique*, lately reviewed in *Science*, begins, in its third number (March, 1884), an interesting series of articles relating to the observatories of France. Stephan, director of the observatory at Marseilles, gives a brief description of the astronomical establishment at that place, with statements as to the nature of the work done since he was appointed director, in 1866. The construction of the observatory was begun in 1862, and terminated in 1878. The *personnel* includes, in addition to the director, Borelly and Coggia, adjunct astronomers; Herse, student in astronomy; and Lubrano and Maitre, computers. Eighteen small planets have been discovered (one by Stephan, one by Cottenot, four by Coggia, and twelve by Borelly), and eleven comets (six by Borelly, and five by Coggia). Magnetic and meteorological observations form a part of the regular work. About seven hundred nebulae have been discovered by Stephan.

— The physicist, as well as the astronomer, will find points of interest in a popular article on the theory of heliostats, by Radau, in the *Bulletin astronomique* for March. The paper is illustrated with engravings of the siderostat and heliostat of Foucault, as well as the modified forms of Silbermann and Littrow. A tolerably full bibliography of the subject concludes the article.

— Small planet (236), discovered by Dr. J. Palisa at Vienna, April 26, has been named 'Honoria' by the discoverer. It is a faint object, being of about the thirteenth magnitude.

— The opening of the new archeological museum in connection with the Fitzwilliam museum took place May 6. The new museum will be an institution for the study of archeology, and the exhibition of objects of antiquity. By its opening, Cambridge is the first in the field of universities in the United Kingdom to provide the necessary facilities for archeological study. The classical section will be second only to the famous institution at Berlin, whose collection of antiques is the finest in the world. Cambridge will thus enjoy a unique position in the United Kingdom; for though Oxford has resolved upon following the example of its sister university, and establishing a similar school, it must — as the project has only recently been decided upon — be some time before it can be brought to maturity. The general direction will be in the hands of Dr. Waldstein, whilst the curatorship of the South-Sea Island department will be undertaken by Baron von Hügel, who, together with Sir Arthur Gordon and Mr. Maudsley, has contributed largely to the magnificent collection of South-Sea Island antiquities.

— The Kentucky pharmaceutical association held its annual meeting at Louisville on the 21st, 22d, and 23d of May. The attendance was an unusually large one, and much interest was shown in the progress of pharmacy and the collateral sciences. Various papers were read, bearing, however, mostly on pharmacy proper; but one of more general scientific interest was reported. It was a paper devoted to the elaboration of a method for the determination of iron by the decoloration of the ferric sulphocyanide by the aid of a definite solution of either mercuric or stannous chloride. The method gave, apparently, very satisfactory results, and has the great advantage of easy application. This paper was by Mr. J. A. Flexuer.

— The programme of the Antwerp exhibition for 1885 is published. It will be under the patronage of the king of the Belgians, and will be opened in May. All industrial products will be included, all goods that are the subject of trade, all materials and tools that in any way concern shipping. The exhibition building will be on the site of the old citadel, near the Scheldt and the new quays, on which space will be allotted for the unloading and shipping of exhibits; the southern railway-station being arranged as a gallery for machinery. There will also be an art-exhibition, a special department for electricity, and one for gardening.

— The Belgian government has sent to the German fisheries department for two hundred and fifty thousand young trout, and fifty thousand young salmon, for the Belgian rivers, and intends to continue their cultivation. Arrangements are being made to allow the salmon to pass through the lochs of the River Maas.

— At a recent meeting of the Electro-chemical society of Berlin there were exhibited specimens of a vegetable carbon, made conductive and incombustible by being strongly heated, either *in vacuo* or in a neutral atmosphere. This artificial graphite does not assume the crystalline structure of the native mineral. We have long known that graphite could be formed by the influence of high temperature, under special conditions. It is now shown by Dr. Aron, that, by the same influence, soot can be rendered as good a conductor as graphite.

— A report on the progress of the devastations caused by Phylloxera in Hungary has been issued by the Ministry of agriculture and commerce. The report states, that, at the end of 1882, there were eighty-two districts found to have been invaded by the pest, irrespective of the smitten districts in Croatia. In May, last year, the examination of all the

vine-growing districts of the monarchy was resumed, with the result, that, by the end of the year, twenty-nine new districts were found to have been invaded. Measures have been adopted in conformity with the law of February, last year, to combat the evil.

— A recent number of the *Comptes rendus* contains an account of some very remarkable observations of the planets Saturn and Uranus, made by Thollon, Perrotin, and Lockyer, at the Nice observatory, under an extraordinarily favorable condition of the atmosphere. On March 16 the outer of the three rings of Saturn was seen to be made up of three separate rings, of slightly greater breadth toward the ball of the planet; and all of these rings appeared at times to be marked with striae, as if there were indefinite subdivisions. Uranus was observed under similar conditions on March 18, and its general appearance is described as similar to that of Mars; that is, dark spots near the central portions of the disk, and on the limb of the planet, at position-angle 380°, a white spot resembling that seen at the Martial poles. The observers, having taken care to eliminate a possible deception by the position of their instrument, also recorded a difference of tint of the two hemispheres, — dark toward the north-west, and toward the south-east, bluish white.

— We learn from M. Veniukoff, that a general convention or council of the authorities, directing geodetic, hydrographic, and other surveys in Russia, has been held for the purpose of agreeing upon a uniform system of conducting the details of such work, for which the government annually expends nearly a million of dollars. At present a universal disaccord prevails in methods of measurement and procedure. Messrs. Struve, Tillo, Faddeieff, Pustchin, and others are members of the board, and the Geographical society is represented by several of its members.

— The *Mittheilungen* of the Verein für erdkunde at Halle, for 1883, contains an extensive bibliography of descriptive literature relating to North Thuringia, the Hartz, and the portion of the North German lowlands appertaining to Saxon Anhalt. This bibliography is the collective work of members of the society, and covers a hundred and seventy-three octavo pages. The same number contains an interesting map, showing the boundaries of the middle and low German dialects from Hedemünde on the Werra, to Stassfurt on the Bode River.

— The much talked of literary undertaking of the Austrian crown prince, 'The Austro-Hungarian monarchy in word and view,' is progressing, and will appear in a popular edition. The first volume will give an abridged view of the physical features and historical development and organization of the country. The first section gives in a series of numbers the provinces represented in the *Reichsrath;* the second relates to the Hungarian provinces; the third section is one volume on the occupied provinces; the concluding section gives a view of the agricultural and economical relations of the different branches of the empire, the dynasty, the army, the home and foreign missions, and political situation, followed by an index of collaborators and references. Each division of the monarchy will find its history, language, literature, customs, and art separately reviewed. The editorship of the Austrian part will be undertaken by Herr Weilen; the Hungarian part, by the poet Moritz Jokai. The expenses will be paid by the emperor. Two subjects in the Austrian part will be undertaken by Prince Rudolph, and one in the Hungarian part. The work will be illustrated with etchings.

— A plant named kappe was shown at last year's Amsterdam exhibition. It is indigenous to Java; and, when its fibres are carefully prepared, they resemble wool, and, when curled, at a moderate cost they can be used for stuffing mattresses. It can also be spun and dyed; but the fibrous appearance it retains shows that a radical improvement in the method of treating it has still to be discovered. All who examined the fibre at Amsterdam were satisfied of its contingent improvement as a textile material.

— The March general meeting of the Russian geographical society was occupied by a communication from Dr. Dybowsky on the Commander Islands, famous for their seal-hunting. Special attention was devoted to the zoölogy. Dr. Dybowsky is the well-known explorer of the fauna of Lake Baikal, and was at St. Petersburg on his way to Lvoff (Lemberg), to occupy there a chair of zoölogy. The April meeting was occupied by an account, by the mining-engineer Tvasroff, on the Pamir expedition of 1883, in which he took part with Capt. Putiata and Benderski. The more is known about this expedition, the more admiration must be felt for the explorers, who did so much under such difficult circumstances. Two more meetings are to be devoted to this expedition, — the May general meeting to the ethnography, and one of the sectional meetings to the physical geography, geology, etc.

— In our last issue we were in error in stating that the board of managers of the Yale college observatory had been abolished. The president of the college has been added to the board, but no decided change in the organization of the observatory will be made till he has become personally acquainted with the needs of the institution.

— The scientific society of Alais, the native place of Dumas, proposes to erect a statue of the famous chemist, and desires subscriptions from all those who felt respect for his name.

— Alphonse Lavallée, the most accomplished dendrologist of our day, died on the 2d of May, at his chateau of Segrez. This is a great and most unexpected loss. A comparatively young man, of apparently robust health, the inheritor of a fine estate not far from Paris, he had devoted his means and his talents to the formation of an arboretum and fruticetum at Segrez, which had already become the best private collection in the world, and to the critical study and illustration of hardy trees and shrubs, with a zeal and ability which inspired the highest hopes, — now, alas! frustrated by untimely death.

SCIENCE.

FRIDAY, JUNE 13, 1884.

COMMENT AND CRITICISM.

Rarely have all the conditions for abounding physical research been so admirably met; rarely has one so fortunate as to be in absolute command of such circumstances been removed in the very prime of life: but still more rarely has the unfinished work of a scientific man, called away under these relations, — only making the fate more inexorable, and the loss more sad, — fallen into hands so competent and appreciative as those of the late Dr. Henry Draper. His work on astronomical spectrum-photography has, since his lamented death in 1882, been reduced and discussed by Professor Young of Princeton, and Professor Pickering of Cambridge, and recently published in the Proceedings of the American academy of arts and sciences. We present in another column a notice of these researches, and may recall, in this connection, the second issue of *Science*, wherein the points of chief interest in the life of Dr. Draper, and the character, in outline, of the more important of his researches, were concisely dealt with. Notwithstanding his fondness for writing, the original published papers of Dr. Draper number only about a score; but many of them represent months, and in some cases years, of consecutive investigation. Had he been spared but a few years more, there can be little doubt that the world of science would, as has been said by one who knew him most intimately, have been enriched with a wealth of discovery almost unparalleled. The calamity of his death has been to some extent mitigated by the painstaking study of his spectrographic work which Professors Young and Pickering have made; Dr. Draper's method as an investigator being such that his death has rendered it possible for his co-workers to derive these results substantially as he would have done himself. To all scientific men engaged in original investigation, however, his sudden death must constitute a potent reminder of the desirability of publication proceeding almost simultaneously with research itself.

The imminent danger of extinction which threatens many of the rare plants of the Swiss Alps has led to the formation of a society for their preservation. On reading the account of this society, presented in another column, the question naturally arises, Are any of *our* rarer species likewise in danger of extermination? With the exception of the extensive raids which are annually made upon some of our native plants by herb-collectors (and it must be understood that this business has assumed very considerable proportions, especially at the South), there are no very large drafts made which imperil the existence of the less common species. To be sure, in a few localities the mayflower and the climbing fern have been extirpated by the greed of collectors for the market; but it can hardly be said that these beautiful species are yet in peril. The same is true of the medicinal plants, ginseng and mandrake. It is fortunate that most species collected for medicinal purposes are reasonably prolific, and will doubtless hold out until those now in fashion have been discarded by other aspirants for popular and professional favor.

Nor are our rarer mountain-plants in any immediate peril. Those who have observed the difficulty apparently experienced by the attendants in White-Mountain hotels, in working up a 'boom' in dried plants, feel little apprehension that the localities will become exhausted. And it should further be noted, that our botanists who collect for exchange are generally very prudent in their use of the rarer species. There is, however, some danger lest the interesting localities where species are found somewhat out of place, so to speak. —

such, for instance, as magnolia at Gloucester, and great rose-bay at Sebago, — may be stripped of their treasures. These 'late-lingerers' possess great interest, and they should long be carefully guarded. But, so far as our rare plants in general are concerned, we do not yet need any society for their preservation: we do, however, need many local societies for their detection, and for critical study of their habits.

A YEAR ago five commissioners of state water-supply were appointed by the New-Jersey legislature to select the best practicable plans for supplying the cities and towns of the state with pure and wholesome water. A report has recently been presented by them to the governor, on the capabilities of the Passaic-River basin for the collection and storage of water for the several centres of population that must now, or in the near future, depend upon it; and a plan elaborated by Mr. L. B. Ward, hydraulic engineer, is appended for the supply of Jersey City, Newark, and other neighboring municipalities. According to this plan, the waters of the Pequannock, a tributary of the Passaic, can furnish sixty million gallons daily, at an expense of two million dollars. With a further cost of three hundred thousand dollars, the supply can be increased to eighty million gallons, sufficient for all probable requirements for twenty years to come. Farther in the future, the Wanaque and Ramapo watersheds can yield an additional two hundred million gallons daily, so as to serve a population of two million eight hundred thousand souls. The chief danger of pollution in the Pequannock valley is of a modern kind: it comes from leakage of the Oil transit company's pipes that carry petroleum from the oil-wells of Pennsylvania to Jersey City; but this danger can be averted by state enactment. Mr. Ward's report contains a well-prepared contour-line map of the Pequannock basin, with darker and darker tints for every elevation of one hundred feet: this is reproduced from a more extended map, based on 'the valuable contoured maps of the New-Jersey geological survey,' and on special surveys by the commission in the adjacent part of New York. In view of the rapid growth of many of our cities, and of the increasing recognition of the value of a good water-supply, this fore-thoughtful action of the New-Jersey legislature should be imitated in other states.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Professor Tait on the reality of force.

THE arguments by which Professor Tait seeks to disprove the objective reality of force, and to justify his advocacy of the exclusion of the term from scientific writing, occupy two and a half pages at the end of a seventy-four page article on mechanics, in the last edition of the Encyclopaedia Britannica. The vigor and confidence with which they are there stated, notwithstanding the author's treatment of forces as real entities in the body of the article, the character of the publication in which they appear, and the eminence of the Edinburgh professor in mathematics and physics, make them worthy of a careful examination.

In the first place, Professor Tait infers that force can have no such reality as matter has, because it is to be reckoned positively and negatively, — an action being opposed by a reaction, — while matter, or mass, is signless. This suggests two comments: 1°. The author never questions the objective reality of space and time, of which realities it is an essential feature, that, to every direction or interval $A-B$, an equal direction or interval $B-A$, of opposite sign, corresponds; 2°. The idea of a negative mass is not a self-contradictory one, and was once widely accepted. The element phlogiston was given up, not because of any absurdity in ascribing levity to material substance, but because a form of matter with positive mass (oxygen), capable of explaining all the phenomena, had been actually separated and identified.

Professor Tait's next criterion of objective reality is quantitative indestructibility, — an attribute shared by time, space, and matter, to which he adds energy. But the evidence of the indestructibility of energy is not of the same nature as that of the indestructibility of matter: for the latter, in all its forms, may be localized, and its density or elasticity measured; while the former, when stored up or 'potential,' cannot be shown to possess a single one of the properties of energy kinetic, or any existence in space, or any objective character whatever. Professor Tait virtually admits this difficulty, and awaits for its solution the discovery of some evidence 'as yet unexplained, or rather unimagined.' All strains and other actions of a clock-weight on its supports are obviously precisely the same — or impalpably somewhat stronger — with the weight wound up an inch as with it wound up a yard; and the existence of a greater 'potential energy' in the latter case is not to be found in the clock, but in the mind, which requires this expression as a form in which to put its conviction that a certain greater amount of work can be obtained. Even though it be admitted that there are no other intelligible terms in which this conviction can be stated, it is clear that the indestructibility of energy is an ideal and subjective truth, and cannot, therefore, be relied on as evidence of a reality distinctively 'objective.'

A third point made by Professor Tait against force is, that its numerical expression is that of two ratios, — the 'space-rate of the transformation of energy,' and the 'time-rate of the generation of momentum.' These results are obtained by simple division, in an equation which expresses the fact that the work done by a body in falling the distance h is just that required to lift it through h against gravity. The fallacy involved in treating the numerical expression for force as force itself has been well exposed by Mr. W. R. Browne, in a criticism of this encyclopaedia article (*Phil. mag.*, November, 1883); and the assumption that ratios are necessarily non-existent is even more fallacious. Were it trustworthy, Professor Tait's equations would lead quite as conclusively to proofs of the non-objectivity of space and time (the former becoming the rate of work-units, the latter of motion-units, per unit of force), and so to a confirmation of the celebrated German view that whatever is universal and necessary in thought belongs to the subject, as to what he deduces from them; or they might even give mass in the form of a ratio, and hence suggest the non-objectivity of matter.

Not the least of the professor's objections against force, it would appear, is that it is 'sense-suggested.' It is a mere truism to say that no other suggestor is possible within the domain of science. It is, perhaps, better worth while to call attention to the indubitable fact that the real ground of the objection against 'action at a distance,' entertained by many physicists, is exactly that such action is not directly suggested by sense-impressions: for this is what they must really mean by calling it 'occult'; actions as our consciousness knows them, and as we can produce them, being generally characterized by proximity undistinguishable from actual contact. Further, if there is any reproach in this epithet, energy is quite as open to it as any function of energy can be: in fact, our senses directly report work in the form of nerve-disturbance, and nothing else. Force is no more truly an inference from nerve-reports testifying of energy exerted, than is matter: in fact, the inference of the independent existence of matter is the less direct and more questionable of the two. The view advocated by Mr. Browne, following Boscovitch, that matter is but 'an assemblage of central forces, which vary with distance, and not with time,' or with direction, is one of great simplicity, as well as suitability to analytic treatment, and one of which no disproof is possible.

It is not too much to claim, therefore, that, in the very difficult task of proving or disproving objective reality, Professor Tait has not here been successful.

HENRY FARQUHAR.

North-eastern and north-western Indian implements.

I do not see that it necessarily follows, because such implements as I have described as 'club-heads' were or are in use among the Ojibwas as 'bone-breakers,' that the Lenni Lenapè used these pebbles for such a purpose, and not in the manner I have suggested. It would naturally be inferred from Miss Babbitt's remarks, that the Dakota puk-gah-mah-gun never varied in its size or shape. If so, then probably no weapons of this pattern have occurred in New Jersey; but this is not true of any form of weapon, agricultural or household implement, ever made by the Indians. They vary indefinitely in size, shape, and degree of finish; and the many forms merge imperceptibly one into the other, as axes into hammers, knives into spears, and these again into arrow-heads. Miss Babbitt herself distinctly states that the two forms of 'club-head' and 'bone-breaker' are essentially the same. If the specimen I figured (fig. 212) in my 'Ancient stone implements of eastern North America' be not a club-head, it does not follow that the more nearly globular fig. 211 was not; and I am glad to be able to state that I have seen just such grooved, globular stones mounted in wooden and hide handles, that were, until very recently, in use by Sioux Indians.

I am very glad that Miss Babbitt has pointed out the use of a large number of these oval, grooved pebbles as 'bone-breakers:' it is a most desirable addition to our knowledge of the archeology of the Atlantic-coast states; and it is now possible to grade and classify this simple pattern of stone implements much more satisfactorily. Of such found in New Jersey, I would say, then, that they are, first, grooved hammers, or mauls; second, club-heads (Dakota, puk-gah-mah-gun); third, 'bone-breakers;' fourth, net-weights.

I suggest this division as based upon the size, the degree of finish, the evidence of use (as in the 'bone-breakers'), and, lastly, the conditions under which many are found. If the flat, discoidal pebbles with side-notches are net-weights, and of this there can scarcely be a doubt, then the smallest of the groove pebbles, which we usually found associated with them, were doubtless put to the same use.

CHARLES C. ABBOTT.

May 18.

Atmospheric waves from Krakatoa.

Mr. H. M. Paul is, doubtless, perfectly correct in insisting (*Science*, iii. 531) that the atmospheric waves following the Krakatoa explosion should not be confounded with the elastic waves producing sounds: in fact, these latter are so brief that it is very questionable whether they would show themselves at all on barometric traces. There would not be time enough for the mercurial barometric column to respond to the momentary compressions and rarefactions: much less would they be indicated by fluctuations extending over thirty minutes or more. The atmospheric waves which encircled the earth, and disturbed the self-registering barometric traces on the 27th of August, 1883, must therefore have been huge aerial gravity-waves, due to the enormous displacement of air produced by the ejection of vast volumes of gaseous products into the atmosphere at the time of this volcanic explosion: they were analogous to the great earthquake water-waves that are sometimes transmitted thousands of miles across oceans.

The point in this connection which needs elucidation is the fact, established by the observations of Gen. Strachey, Professor Förster, and others, that the velocity of these waves was approximately the same as that of an elastic sound-wave in air. It is the near coincidence of these velocities which has led to the confounding of these gravity-waves with elastic sound-waves. The approximate identity of the velocities in these two cases may be traced to the relation existing between the elasticity or resilience of the air, on which the velocity of sound depends, and the height of a homogeneous atmosphere, on which the velocity of long aerial gravity-waves depends.

It is well known that the mathematical investigations of Sir G. B. Airy and others, confirmed by the experimental results of Scott Russell, show, that, in the class of water-waves in which the wave-length bears a large ratio to the mean depth of the water, the velocity of propagation of the wave is sensibly

equal to the velocity acquired by a heavy body in falling vertically *in vacuo*, under the action of gravity, through half the mean depth of the water. Now, it is highly probable, that, notwithstanding the variable density of the atmosphere with altitude above the surface of the earth, the same formula is applicable to long gravity-waves propagated in it; viz., that the velocity of the wave is equal to that which a heavy body would acquire in falling vertically through half the height of a homogeneous atmosphere.

It is likewise well known, that the illustrious Newton (Principia, book ii. prop. 49), neglecting the influence of the thermal changes incident to the propagation of aerial elastic waves, deduced a most remarkable but imperfect formula for the velocity of sound in air, making it equal to that which a heavy body would acquire in falling vertically through half the height of a homogeneous atmosphere whose weight or pressure measures its elasticity.

It will be noticed that the velocity of sound by Newton's formula is precisely the same as that given by the hydrodynamical formula for long aerial gravity-waves. It is true, that, in consequence of the heat momentarily developed or absorbed during the condensations and rarefactions of the air, the actual velocity of sound exceeds that computed by the Newtonian formula by about one-sixth (a correction of the formula supplied by Laplace); yet the approximation is sufficient to seemingly co-ordinate the velocities of these diverse kinds of aerial waves.

Thus, the height of a homogeneous atmosphere, under standard conditions, being 7,990 metres, the velocity of sound computed by the Newtonian formula equals 279.96 metres per second at 0° C., and 293.5 metres per second at the August temperature of 27° C. The actual velocity of sound at above-indicated temperatures equals 332.5 and 348.6 metres per second respectively.

On the other hand, the following are some of the estimates that have been made of the velocity of the Krakatoa atmospheric waves:—

		Velocity in metres per second.
Gen. Strachey	in England	301.3 to 315.0
Professor Förster . . .	at Berlin	278.0
Mr. Renou	at Paris	246.0 to 278.0
Mr. Renou	in France	305.0 to 319.0
Mr. Wolf	at Paris	325.8
Mr. Baillaud.	at Toulouse . . .	324.0
Mr. Hall	at Jamaica	308 5

All of these estimates fall decidedly short (as theory indicates) of the actual velocity of sound in air; and most of them approximate somewhat more nearly to the velocity computed by the Newtonian formula, which, as we have seen, corresponds with the hydrodynamical formula for long aerial gravity-waves.

Considering the inherent difficulties of the precise determination of the several data requisite for deducing the true velocity of the atmospheric waves originating at Krakatoa on this occasion, we need not be astonished at the considerable divergence in the estimates, or that the assumed exact coincidence of velocities of the two kinds of aerial waves fails to be verified in an accurate manner, either by theory or by observation.

JOHN LECONTE.

Berkeley, Cal., May 15.

A near view of Krakatoa in eruption.

In connection with the remarkable atmospheric wave, which, starting from Krakatoa at the time of the eruption, "travelled no less than three and a quarter times round the whole circumference of the earth,"[1] the following extracts from the log of a vessel sailing in the close vicinity of Krakatoa may be of interest:—

Extracts from log of barque William H. Besse, from Batavia towards Boston.

Aug. 26.—This day commences with light airs and calms. Light airs throughout the day. At 5.30 P.M., wind hauling ahead, let go starboard anchor with thirty fathoms chain, clewed up and furled all sail. Adam light bore W. 1-4 S. and E. by S. Throughout the afternoon and night, heard heavy reports, like the discharge of heavy artillery, sounding in the direction of Java Island. Very dark and cloudy throughout the night, with continual flashes of lightning. Barometer 30.15.

Aug. 27.—Commences with strong breezes, and thick, cloudy weather. Barometer 30.12. At 9.30 A.M., pilot left ship. Hove the lead every fifteen minutes. At daylight noticed a heavy bank to the westward, which continued to rise; and, the sun becoming obscured, it commenced to grow dark. The barometer fell suddenly to 29.50, and suddenly rose to 30.60. Called all hands, furled every thing securely, and let go the port anchor with all the chain in the locker. By this time the squall struck us with terrific force, and we let go starboard anchor with eighty fathoms chain. With the squall came a heavy shower of sand and ashes, and it had become by this time darker than the darkest night. *The barometer continued to rise and fall an inch at a time.* The wind was blowing a hurricane, but the water kept very smooth. A heavy rumbling, with reports like thunder, was heard continually; and the sky was lit up with fork lightning running in all directions, while a strong smell of sulphur pervaded the air, making it difficult to breathe. Altogether, it formed one of the wildest and most awful scenes imaginable.

The tide was setting strong to the westward throughout the gale, at the rate of ten knots per hour. At 3 P.M. the sky commenced to grow lighter, although the ashes continued to fall. The barometer rose to 30.30, and dropped gradually to 30.14, when it became stationary. The whole ship, rigging and masts, were covered with sand and ashes to the depth of several inches.

Aug. 28.—Commences with light airs, and thick, smoky weather. Hove up starboard anchor, and hove short on port anchor. Dead calm throughout the day and night. Saw large quantities of trees and dead fishes floating by with the tide; the water having a whitish appearance, and covered with ashes. This day ends with a dead calm, and thick, smoky weather.

Aug. 29.—This day commences with calms, and thick, smoky weather. Made all sail throughout the day. Moderate winds, and thick, smoky weather. Passed large quantities of driftwood, cocoanuts, and dead fishes. At 8 P.M., passed Anjier,[2] and could see no light in the lighthouse, and no signs of life on shore. Furled all light sails, and stood under easy sail throughout the night. Day ends with moderate winds and cloudy weather. Barometer 30.14.

Aug. 30.—Commences with moderate winds and cloudy weather. At daylight made all sail with a fresh breeze from the westward. Found the water for miles filled with large trees and driftwood, it being almost impossible to steer clear of them. Also passed large numbers of dead bodies and fish. Kept a sharp lookout on the forecastle throughout the day.

[1] *Nature*, vol. xxx. p. 12.

[2] All except the foundation of the lighthouse was destroyed by the tidal wave.

At 10 A.M., sighted Java Head lighthouse; but the wind hauling ahead, we kept away, and went round Prince Island. Latter part, fresh breezes, and thick, smoky weather. Friday and Saturday, passed large quantities of ashes in the water. Saturday, crew employed in cleaning ashes off masts and rigging. Water had a green color.

The point of special importance in the above account is the record of the sudden barometric fluctuations, due to the great air-wave with which readers of *Science* are already familiar.

Accompanying the above extracts from the log, is a sample of the 'sand and ashes' which fell so thickly upon the rigging. It is of a light gray color, and harsh to the touch. It is essentially a pulverized pumice, by far the greater part of it consisting of fragments of volcanic glass. These fragments are sometimes twisted, but generally in flat, angular transparent scales, which are filled with minute bubbles, and, of course, are isotropic. Angular fragments and crystals of transparent plagioclase, occasionally showing the hemitropic striations, and giving bright colors in the polariscope, together with more irregular and rounded fragments of dark green and brown pyroxenic minerals, probably augite and hypersthene, are scattered very occasionally among the glass particles. Grains of magnetite, often well rounded, also occur, and may be picked out and examined separately by a magnet covered with tissue-paper.

The dust collected by Mr. Joseph Wharton, from snow which fell in the suburbs of Philadelphia on Jan. 22, and supposed by him to be of volcanic origin,[1] has been kindly submitted by him to the writer for examination. It is composed of particles of quartz, coal, cinders, vegetable matter, etc., among which are certain glassy hairs and rounded globules. These bear no resemblance to the angular glass fragments composing the Krakatoa dust, which is remarkably free from either filaments or globules; and the supposed volcanic glass particles in the Philadelphia dust appear to be of local origin, — from blast-furnaces, founderies, or the like.

For the vial of dust, and the extracts from the log, I am indebted to my friend, Rev. Wayland Hoyt, D.D., of this city. H. CARVILL LEWIS.

Philadelphia, May 27.

[1] *Science*, Feb. 1, 1884, p. 139.

Professor Gill on assumptions of museum-keepers.

In a recent issue of *Science*, p. 615, my friend Professor Gill has made a rather savage attack upon another very good friend of mine, for which I feel in some degree responsible, since a remark in my review of the 'Voyage of the Challenger' has been taken by the former as a text for his phillipic. I have no desire to cross swords in argument with so skilful a dialectician as Professor Gill, and shall therefore be contented to make certain general statements.

1. The policy of Dr. Günther, as keeper of the zoölogical collections of the British museum, has, from the start, been an extremely liberal one, much more so than that of his predecessor. I know of no museum where facilities are more readily granted, the methods in the natural-history department and in the great library of the British museum being precisely similar. Any person known to the authorities may secure the use of a table in one of the laboratories, and may have specimens brought to him day after day, from morning till night, as fast as he can fill up and sign the requisitions. That this is so, I can testify from personal knowledge. Within the past eighteen months, I have known of seven ichthyologists, — three from the United States, one from Italy, one from France, one from Sweden, and one from Australia, — each of whom spent weeks in the museum, and had no specimens refused him. I have also known of several other American zoölogists who have been treated with equal courtesy. I may mention, in passing, that no person, not an officer of the museum, is ever allowed to work in a room by himself, no matter how well he may be known, — a precaution which I believe to be quite necessary, since privileges of this sort have in the past been shamefully abused. I might mention one instance, many years ago, in which the entire collection of alcoholic specimens in one group of vertebrates was badly mutilated by a series of coarse dissections, carried on, without the knowledge of the authorities, by a young student, now one of our most distinguished American zoölogists. I have heard the story from his own lips, as well as from Dr. Günther.

2. The Challenger fishes are not, as yet, turned over to the British museum, but are still under the control of the lords of the admiralty, by whom, through Sir Wyville Thompson, Dr. Günther was requested to prepare the report upon the ichthyology of the expedition. Dr. Günther, therefore, in my opinion, is perfectly right in retaining this collection under his own control until his report is completed, after which they will, no doubt, become the property of the British museum, and be open to inspection under museum rules. The distinction between Dr. Günther in the capacity of keeper of the zoölogical collections of the British museum, and Dr. Günther in the capacity of naturalist, engaged upon the Challenger report, should be carefully observed.

Professor Gill refers to a case in which a certain European ichthyologist has recently been refused the privilege of examining the Challenger collections. Not being in possession of all the facts in the case, I shall not attempt to explain it. This I do know, however, that, at the time referred to, the Challenger fishes were being moved, together with the natural-history collections of the British museum, from Bloomsbury to South Kensington, and were in large part packed in boxes, so that they were really inaccessible; but a portion of the collection was still upon a table in Dr. Günther's private office: and these specimens, as well as others in his own house, were freely shown by him to Dr. Bean and myself. I cannot doubt that the same privilege would have been extended to any other ichthyologist who had made any reasonable request for the use of the material. It should be remembered, however, that these collections were not worked up in any way, were neither catalogued nor labelled, and were held by Dr. Günther as a personal trust from the Challenger survey, and had not yet passed into his official custody.

The question as to the extent to which any specialist, charged with the duty of working up collections made by a government expedition, may reserve to himself, while engaged in the preparation of his report, the handling of the material, is one into which I do not wish to enter at present. Professor Gill is apparently of the opinion that some question of moral principle is involved, and that working naturalists should be communists in respect to the use of material. The only point which I desire at present to make is this, that Professor Gill has evidently been misinformed as to the manner in which Dr. Günther has administered his trust as custodian of the zoölogical collections in the British museum.

In conclusion, I desire to enter a serious protest against the bitter and unreasonable criticisms upon Dr Günther's work which have of late years so fre-

quently appeared in American journals. Criticism which ignores all that is good, and exaggerates all that is imperfect, in the work of any specialist, especially in that of so eminent a master as Dr. Günther, is greatly to be deprecated. G. BROWN GOODE.

Washington, June 1.

'A singular optical phenomenon.'

With reference to the 'optical illusion' to which your correspondent 'F. J. S.' drew attention (*Science*, No. 57, p. 275), and which has been abundantly illustrated and explained in later numbers, may I suggest to your readers who have not yet witnessed the phenomenon, to beg, borrow, or buy a few square inches of that finely perforated card which ladies were accustomed to use a good deal for working book-markers, initials, and the like.

There are several ways of using it with good effect. 1°. Before cutting the sheet, use it with a hand-mirror, standing (*a*) with the back to the light, and looking *through* both the real and the reflected cards; (*b*) facing the light, and looking through the one, *at* the other. 2°. Cut off a strip if the quantity available is restricted: otherwise divide in two more equal portions, and holding the smaller in one hand, between the eye and the larger, vary the distances absolutely and relatively, and also the relative inclinations (in their proper parallel planes); in this case, also, varying the position with respect to the light. 3°. Use the same close to a strong light, in such a way that the first surface (and the fourth) shall be in shade, while the second, and more especially the third, shall be in strong light.

The variations possible are, of course, far too numerous to admit of categorical statements. Still less can I attempt to describe what is seen. Nor, indeed, would it be a sensible proceeding to describe what is at once so easy, and so very much more interesting to see. My object is merely to point out the means and the manner.

I will, however, mention two of the more curious aspects presented. 1°. When a luminous background is seen through the reflected screen, and the latter is moved freely about in its own plane (which, of course, is supposed parallel to the glass), the phantom screen remains *stationary*. 2°. When one screen is held at arm's length, and the other two or three inches nearer to the eye, so as to produce a phantom some three or four times the size of the real pattern, the circumstances are favorable for concentrating attention on the contrast of colors presented. What I see is a sharply-defined rectangular network, as of blue steel wires with secondary and tertiary nets of doubtful color and indistinct form. As the intermediate screen is brought nearer to the eye, up to halfway, the intensity of color of the blue netting is much increased. I cannot pretend to give an exact indication, as I have only made a sort of hasty reconnoissance of this field. I notice, however, that the phenomenon presented by *inclining* the axes of the patterns to each other produces a wonderfully kaleidoscopic appearance.

To pursue the experiments, I should wish to use different patterns of perforation, and differently colored lights. J. HERSCHEL.

23 Suffolk Street, Pall Mall East,
London.

Guyot's 'Creation.'

In the notice of Guyot's 'Creation' there is an error which makes me say precisely the opposite of my meaning. On p. 601, first column, fifth line, for 'only' read '*more than.*' WRITER OF THE NOTICE.

PRESIDENT ELIOT ON A LIBERAL EDUCATION.

PRESIDENT ELIOT's address before the Johns Hopkins university in February last, which appears in the June *Century*, though radical from one point of view, is not so from another. In maintaining that Greek should no longer be an indispensable requisite to the bachelor's degree, he takes what the conservative educators must regard as very radical ground. But when we examine what he would substitute for Greek, and what studies he regards as affording the most profitable culture, we see that he does not take the same view as the advocates of scientific education. The studies which he would elevate as at least co-equal with Greek, are the English language and literature, the French and German languages, history, political economy, and natural science. A careful examination will show that this proposed change would not be the substitution of a scientific for a literary culture, but rather the contrary. The leading studies in literature are now Greek and Latin; the modern languages, literature and history, being confessedly taught in a comparatively imperfect way. By adding history and the three modern languages to the curriculum from which the student makes his choice, a very large addition is made to the literary side of the banquet. This addition is hardly compensated by the increased consideration which he would give to political economy and natural science.

While it seems, therefore, that we can hardly regard President Eliot as a pronounced partisan of a scientific education, it must be admitted that the ground taken by those who are such partisans is not very definite. Their stereotyped complaint is that too much attention is given to languages and mathematics. Scientific studies are thus placed in contradistinction to those two subjects. Now, comparing our own education with that of other countries, it can hardly be claimed that we pay disproportionate attention to either mathematics or languages in this country. Not only is our mathematical education far behind that of France and Germany, but a much better mathematical training than our average student gets is absolutely necessary to an adequate comprehension of modern physical science. To take an example: it is safe to say that the number of our college graduates who know mathematics enough to understand clearly what physicists mean by the terms 'conservation' and 'transformation of energy,' is very small. One fact well worthy of consideration on both sides is, that, notwithstanding that the Germans

are among the foremost in scientific research, they are also far ahead of us in the thoroughness with which they learn the modern languages and mathematics. It is probably safe to say, that the average doctor of philosophy who has just graduated from a German university speaks and understands both French and English better than nine-tenths of American masters of arts speak or understand either French or German; that he reads Greek equally well with his American compeer, and Latin a great deal better; he also has as good command of mathematics as the best half of the American graduates, and possibly as good command as the average American professor of our three hundred colleges. It would seem, therefore, that the whole story is not told, when it is claimed that the two studies alluded to, receive a disproportionate share of attention.

President Eliot does not define very fully what he includes under the head of natural science; but as he would give no more attention than at present to mathematics, and as such attention is absolutely necessary to any improvement in our general understanding of a physical science, we may assume that he refers principally to the biological sciences, especially botany, zoölogy, and animal and vegetable physiology. The advocates of a scientific education will probably reply, that it depends altogether on the way in which natural science is taught, whether it should take a more prominent place in the curriculum. If the teaching is confined to the regular routine of the past, and is to terminate in the ability of the student to name and describe the plants and animals which he may meet with in his rambles, a very little will suffice, though that little may be important.

With this great addition to the curriculum, it is evident that no one student can master the whole, or any considerable portion of the whole. The president of Harvard is well known as an advocate for the optional character of studies: in fact, he would permit option much earlier than it is now permitted. Yet as he would require, as a condition of admission to colleges, a proficiency in three out of the four languages, — French, German, Latin, and Greek, — he would, perhaps, not go so far in this direction as one might suppose from the general tenor of his discourse. In fact, from what he had just said of the extremely imperfect character of the knowledge which a student can possibly get of Greek and Latin in the usual course, — of metaphysics from a single text-book of moderate size, of physics from a manual of a few hundred pages, of political economy from a single short treatise, — it would be inferred that he considers such imperfect knowledge as not worth acquiring. However this may be, it is certain, that, in permitting a student to choose from the beginning that subject for which he has the most capacity, President Eliot gives expression to a very popular view of the subject; but there is something to be said on the other side. One of the great objects of a liberal education is to secure community and sympathy of thought and feeling among the great body of educated men. If, now, among these men, are found very different natural aptitudes for special studies, it is clear that the end will be best reached by adopting a system of training for every man in that class of subjects for which his natural capacity is the weakest. If, as the writer suspects, the actual differences of capacity are not so great as the apparent differences in facility of acquisition on the current system, and if the apparent lack of talent among students in special subjects arises principally from those subjects not being presented to them in the way in which their minds are best able to grasp them, we may entertain a reasonable hope of coming nearer a common system of culture by suiting the method of teaching to the pupil.

The writer does not think that President Eliot squarely hits the point, when he indicates a preference for a thorough study of some one subject over what he considers an imperfect knowledge of a number of subjects. Properly speaking, a thorough knowledge of any one subject belongs to a professional, and not to a liberal education. The author can do little more than repeat, what he has probably said more than once before, that the main object of a liberal education should not be minuteness of knowledge, but a thorough understanding and mastery of those elementary ideas which form the foundation of all knowledge. If any system of training can be discovered which will enable the student to see the economical fallacies to which all men seem to be liable, on the subjects of the currency, the employment of labor, and the protection of home industry, as plainly as he sees the same fallacies when applied to his own every-day work, then that system would have the highest claims upon us, as supplying what was wanted to form a liberal education. The text-books adapted to such a system would be small; but they would have to be supplemented by a large amount of work, on the part of the living teacher, of a different kind from that commonly expected of him in this country.

S. Newcomb.

THE MIDDLE YUKON.[1] — II.

WHEN we were nearly ready to start, on the morning of the 17th, we found four Ayan Indians, in as many canoes, at our camp, from the Kah-tung village above, they having left it shortly after we had, and camped just above us on the river for the night. They were going down the river some two hundred to three hundred miles, to a white trader's, and we kept passing each other for the next three or four days. I found the floating of the raft, carefully kept in the current for from twelve to fourteen hours each day, with no detentions, fully equalled the average day's journeys of the canoes, which were in the water but seven or eight hours a day; their occupants stopping to hunt every animal that was seen, and to cook a midday lunch. In fact, my Indians that traded among them more than hinted that they were hurrying in order to go along with us.

I should have stated, that on the 16th we had a number of disagreeable thunder-showers in the afternoon; their rarity ont his river making them interesting to note. The Ayans that met us on the morning of the 17th had with them the carcass of a black bear, which they offered us for sale: and on buying one hindquarter, all that we could use, they offered us the rest as a present; which offer being accepted only as far as the other hindquarter, the rest was left by them on the gravel-beach, which was explained by the fact that all four of these were medicine-men, and as such they never partook of bear-meat. They told us that it was the bear we had seen the day before.

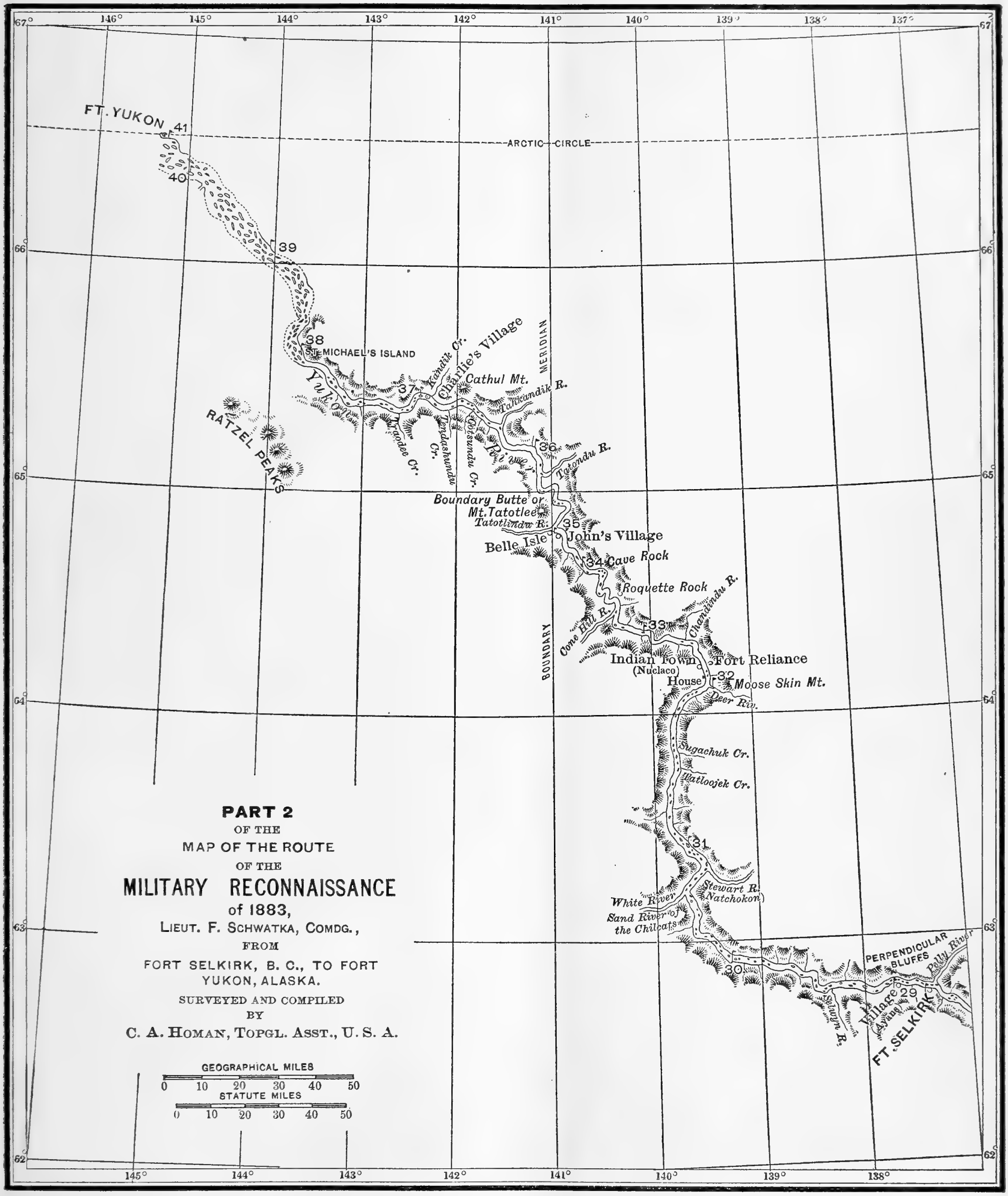
The morning of the 17th, and, in fact, intervals during the day, were characterized by a heavy fog, not quite reaching the river-bottom, but cutting the hills at an altitude of from three hundred to four hundred feet above the level of the stream. It gave the country a dismal air, but was much better in physical comfort than the day before, with its alternating rain and blistering heat. We found these fogs to be very common on this part of the river, being almost inseparable from the southern winds, the prevailing ones at this time of the year. I suppose the fog results from the moisture-laden air over the warm Pacific crossing the glacier-capped mountains of the Alaskan coast, and reaching this part of the Yukon valley with its aqueous vapor precipitated as rain or fog. About half-past one in the afternoon we floated past the mouth of the White River, coming in from the south, which has the local name of Yu-ko-kon Heen-a, or Yukokon River, a much prettier name than the old one of the Hudson-Bay traders. The Chilcats call it the Sand River, from the innumerable bars and banks of sand along its course; and many years ago they ascended it by a trail, which, continued, leads to their country, but is now abandoned. Forty or fifty miles up its valley the trail leading from the head of the Tanana to old Selkirk crosses its course; and since Fort Selkirk was burned in 1851, the Tanana Indians, who then used it considerably to reach that point for trading, travel it but little. It seems to flow almost liquid mud (and no better example of its extreme muddiness can be given than to state that one person of the party mistook a mass of timber on the up-stream side of a low, flat mud-bar, for floating timber, and as evidence of a freshet, which seemed apparent from the muddy water, until its permanent character was established by closer observation). The mud-bar and adjacent waters were so exactly of the same color, that the line of demarcation was not readily apparent. The Indians say that it rises in glacier lands, and that it is very swift, and full of rapids, along its whole course. So swift is it at its mouth, that it pours its muddy waters into the rapid Yukon, and carries them nearly across that stream; the waters of the two streams mingling almost at once, and not running for miles distinct, as is stated in one book on Alaska. From its mouth to Bering Sea, the Yukon is so muddy that it is noticeable even when taken up in the palm of a hand; and all fishing with hook and line ceases.

About four in the afternoon the mouth of the Stewart River was passed, and, being covered with islands, would not have been noticed except by its valley, which is very conspicuous. A visit to the shore showed its mouth to be deltoid in character, three mouths being noticed, and probably more existing. Islands were very numerous in this vicinity, and covered with spruce and poplar. The swift current, cutting into their alluvial banks, kept their edges bristling with freshly fallen timber; and it was almost destruction to get under this *abatis* of trees with the raft, in the powerful current, and some of our hardest work was to avoid it, — a very hard thing to do, as, where they were the thickest, the current set in the strongest.

It may be necessary to explain how a greater amount of such fallen timber should exist on this river than on any other in the temperate zones equally wooded, and I think I can do so to the satisfaction of my readers. Fig. 10 represents a bank of any river, the stumps *s s*

[1] Concluded from No. 70.

representing trees, which, if undermined as far as *c*, will generally tumble in along *c d*, and carry away a couple of trees, the roots of not more than one being able to hold it so as to form an *abatis* along the bank. Fig. 11 represents a similar sketch on this part of the Yukon; the banks, as we saw them, being generally about eight feet above the level of the water. This is about the depth to which the moist ground freezes solid; and the banks, therefore, have the tenacity of ice to support them; and it is not until the water has eroded



as far as c (five or six times as far as in fig. 10) that the superincumbent weight becomes great enough to break off the projecting bank along $c\,d$; and $c\,d\,S$, as a solid, frozen mass, tumbles in around the axis c, and, being too heavy for the water to sweep away, it remains until thawed out and washed away. I have roughly attempted to show this in fig. 12. I think any one will acknowledge that the raft R, carried by a current sweeping towards C, is not in a very desirable position. It is generally bad enough on any river with a single line of trees along its scarp, but on the Yukon it is as much worse as I have shown. In fig. 12 the maximum is depicted just as the bank falls; and it requires but a few days for all the outer trees to be packed away by the swift current, and a less bristling aspect presented, the great mass acting somewhat as a barrier to again erode the bank for a long while. In many places along the river, this undermining had gone so far that the bank seemed full of caves; and, drifting close by, one could see and hear the dripping from the thawing surface, $c\,S$ (fig. 11). In other places the half-polished surface of the ice could be seen in recent fractures as late as July, and even August.

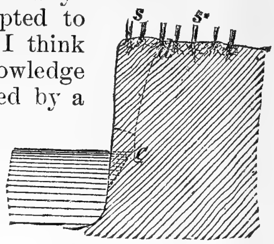


Fig. 10.

On the 18th, shortly after noon, we passed a number of Indians on the right bank with sixteen canoes. It was probably a trading or hunting party, there being one for each canoe, and no women with them. About 8.30 P.M. we passed an Indian camp on the left bank, which, from the apparent good-looking quality of their tents as viewed from the river, we thought might be a mining-party. From them we learned that a deserted white man's store was but a few miles farther on, but that the man had left a number of months before, going down to salt water, as they expressed it. We camped that night at the mouth of a conspicuous but small stream coming in from the east, that we afterwards learned was called Deer Creek by the traders, from the large number of caribou seen in its valley at certain times of their migrations. At this point the Yukon River is extremely narrow for such a distance from its head, and considering its previous mean width, being between two hundred and two hundred and fifty yards. It must have great depth, for its increase in current does not seem adequate to carry its previous volume.

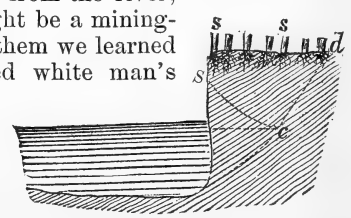


Fig. 11.

Believing I was now near the British boundary, I reluctantly determined on giving a day (the 19th of July) to astronomical observations, — reluctantly, because every day was of vital importance in reaching St. Michael's, near the mouth of the river, in time to reach any outgoing vessels for the United States. That day, however, proved so tempestuous, and the prospects so uninviting, that, after getting a couple of poor 'sights' for longitude, I ordered camp broken, and we got off at 11.10 A.M. A few minutes before one o'clock we passed the abandoned trading-station on the right bank of the river, which, we surmised from certain maps, and information received afterwards, was named Fort Reliance. It was a most dilapidated-looking frontier pile of shanties, consisting of one main house, the store above ground, and three or four cellar-like houses, the roofs of which were the only parts above the level of the ground. We afterwards learned that the trader, Mr. McQuestion, had left, fearing some harm from the Indians.

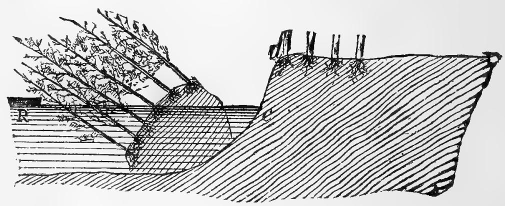


Fig. 12.

Nearly opposite Reliance was the Indian village of Noo-klak-o, numbering about a hundred and fifty souls. Our approach was announced by the firing of from fifty to seventy-five discharges of guns, to which we replied with a much less number. This method of saluting is very common along the river, from here down, and is an old Russian custom that has found its way this far up the stream, much beyond where they ever traded. It is a custom often mentioned in descriptions of travels farther down the river. The permanent number of inhabitants, according to Mr. McQuestion, was about seventy-five to eighty; and therefore there must have been a great number of visitors among them at the time of our passing. They seemed very much disappointed that we did not visit them, and the

many that crowded around the raft spoke only of tea and tobacco. Their principal diet, I understand, is moose, caribou, and salmon. Their village is a semi-permanent but squalid-looking affair, — somewhat like those of the Ayans, but with a greater predominance of canvas.

Starting at 8.10 A.M., next morning, from camp 33, at 11.30 we passed a good-sized river coming in from the west, which I named the Cone-Hill River, from the fact that there is a conspicuous conical hill in its valley, near the mouth. Just beyond the mouth of the Cone-Hill River we saw three or four bears, both black and brown, in an open or untimbered space on the steep hillsides of the western bank. We gave them a volley, with no effect except to send them scampering up the hill into the brush. I was told by a person in southern Alaska, undoubtedly conscientious in his statement, and having considerable experience, that the brown and black bear of his district never occupied the same localities, and although these localities might be promiscuously mixed, like the spots on a checker-board, yet each species of them remained rigidly on his own color, so to speak; and this led him to believe that the weaker of the two, the black bear, had good reasons to be afraid of his more powerful kind. This day's experience of the two kinds together, in one very small area, shows either an error of judgment of the observer mentioned, or a peculiarity of temper in the animals we saw. My authority spoke also of the manner in which the Indians per-persistently avoided the haunts of the brown bear, and this terror of that animal I found to exist as far as my travels extended.

After leaving the Stewart River, which had been identified by a sort of *reductio ad absurdum* reasoning, I found it absolutely impossible to identify any of the smaller streams clearly from the descriptions and maps now in existence, and aided by the imperfect information gained from the local native tribes. Between 2.30 P.M. and 3 P.M. we floated past a remarkable-looking rock, standing conspicuously in a flat, level bottom of the river, and very prominent in its isolation.[1] It very much resembled Castle Rock on the Columbia, but is only about half its size. Dark, lowering clouds still obscured the tops of the river-hills. At half-past twelve we came upon an Indian village of a permanent character, of some six houses, on the western bank of the river, which is generally called Johnny's village, the Indian name being Klat-ol-klin. It numbered from seventy-five to a hundred souls; and on the gravel-beach in front of the row of houses were probably from one-fourth to one-third as many canoes of the birch-bark variety, but larger and clumsier in construction than those of the Ayans. A number of long leaning poles, braced on their down-hill ends by cross uprights, were also seen; and these serve as scaffoldings for drying salmon, and to keep them from the many dogs while going through this process. While taking a photograph, two or three salmon fell from the poles; and in a twinkling, I think fully sixty or seventy dogs were in a writhing mass over them, each one trying to get his share. These dogs were of a smaller breed, and noticeably of a darker color, than the Eskimo dogs of the lower river. They subserve these Indians the same purpose. The body of the houses is of a very inferior quality of log construction, in which ventilation seems to be the predominating idea (although even then not to a sufficient degree, as judged by one's nose upon

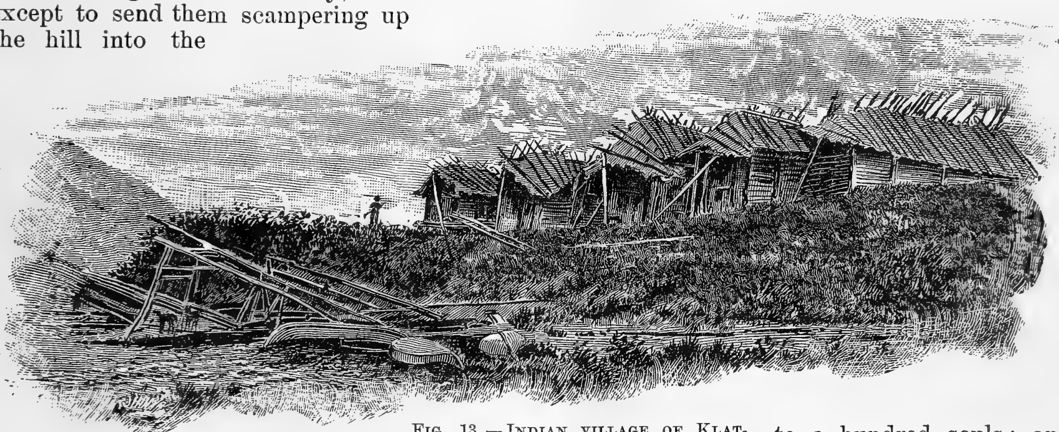


FIG. 13. — INDIAN VILLAGE OF KLAT-OL-KLIN, OR JOHNNY'S VILLAGE.

[1] Called the Roquette Rock, after M. Alex. de la Roquette of Paris, France.

entering), and the large door in front is roughly closed by a well-riddled moose or caribou skin, or occasionally a piece of canvas. The roof is of skins battened down by spruce poles. The row of houses is so close to the scarp of the bank, that the 'street' in front is a narrow path, where two persons can hardly pass without stepping indoors or down the hill, and, when I visited the village, was so monopolized by scratching dogs that I could hardly force my way through. A fire is built on the dirt-floor in the centre of the habitation, and the smoke left to get out the best way it can. As the occupants are generally sitting flat on the floor, they are in a stratum of air comparatively clear; for the smoke can find air-holes through the cracks of the house-walls, while that which is retained under the skins of the roof is utilized to smoke the salmon which are hung up in this space.

It was at this village that to me the most wonderful and striking performance ever given by any natives we encountered on the whole trip was displayed, and in this I refer to their method of fishing for salmon. I have spoken of the extreme muddiness of the Yukon from the mouth of the White River; and this spot, of course, is no exception. I believe I do not exaggerate in the least when I say, that, if any ordinary pint tin cup was filled with it, nothing could be seen at the bottom until the sediment settled. The water is from eight to twelve feet deep on the banks in front of their houses, where they fish with their nets; or at least that is nearly the length of the poles to which the nets are attached. The salmon that I saw them secure were caught about two hundred and fifty or three hundred yards out from the bank, directly in front of the houses. Standing in front of this row of cabins, some person, generally an old squaw, possibly on duty for that purpose, would announce that a salmon was coming up the river, when some man, identifying its position, would run down to the beach, and pick up his canoe, paddle, and net, and start out into the river rapidly; the net lying on the canoe's deck in front of him, his movements being guided by his own sight and that of a half-dozen others on the beach and bank, all shouting to him at the same time. Evidently, in the canoe he could not judge well at a distance: for he seemed to rely on the advice from shore until the fish was near him, when, with one or two dexterous and powerful strokes with both hands, he shot the canoe to the position he wished; regulating its finer movements by the paddle in his left hand, while with his right he plunged the net the whole length of its pole to the bottom of the river, from eight to twelve feet; often leaning well over, and thrusting his arm deeply into the water, so as to adjust the mouth of the net (covering about two square feet) directly over the course of the salmon. Of seven attempts, at intervals covering three hours, two were successful, salmon being caught weighing about fifteen pounds. How these Indians at this great distance can see isolated running salmon on the bottom of an eight or ten feet deep river, and determine their position near enough to catch them in the narrow mouth of a small net, when under the eye a vessel holding that many inches of water from the river completely obscures an object at its bottom, is a marvellous problem that I will not attempt to unravel; it of course depends in some way on the motion of the fish. In vain they attempted to show members of the party the coming fish. I feel perfectly satisfied that none of the white men saw the least traces that the natives tried to show. In their houses and on the scaffoldings were several hundred that had been caught in this way. The only respectable theory that I could evolve, was that the salmon came along near the top of the water, so as to show, or nearly show, the dorsal fin (for it borders on the marvellous that they could be seen at the bottom, or that any motion of theirs could be detected from the top when they were on the bottom, among the ripples of the swift muddy stream), and that when they neared the canoe, the sight of it, or more likely some slight noise, probably made on purpose, sent them to the bottom without any considerable lateral deviation, and that they were thus directed into the net; but my interpreter told me that this superficial swimming did not take place, but that the motion of the fish was communicated clear to the top from the bottom. The nets used I have partially described already. The mouth is held open by a light wooden frame of a reniform shape, as shown in fig. 14;

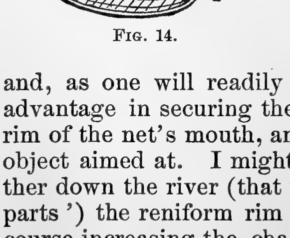


Fig. 14.

and, as one will readily see, this is of great advantage in securing the handle firmly to the rim of the net's mouth, and is undoubtedly the object aimed at. I might state here, that farther down the river (that is, in the 'lower ramparts') the reniform rim becomes circular, of course increasing the chances of catching the

fish; all the dimensions also become much larger. It may be interesting to state, that, when the fish is netted, a turn is given to the handle, thus effectually trapping it below the mouth; and, when brought up alongside, a fish-club (fig. 15) is used to kill it immediately, for the struggles of so large a fish might easily upset a fragile canoe. A number of Hudson-Bay taboggans were seen at the Indian village, and near the trading-station, on scaffolds, and seem to be the principal sledges of the country. Their snow-shoes differed from those of the Chilcats only in immaterial designs.

FIG. 15.

The next day, the 22d, while under way, we saw a dead king-salmon floating belly upwards, and on the lower river saw a few, but never saw the numbers spoken of by previous travellers. I now noticed, in many places in the flat river-bottoms (with high banks, however), that the ground, especially in open places, was covered with a springy moss or peat; and if the bank was at all gravelly, so as to give good drainage, and allow the water to scour out underneath, as usual in temperate climes, and not in immense frozen masses, as previously described, this sphagnum was so tough that it would not go with the banks, but remained attached to that of the crest, forming great blankets a foot thick, that overhung the shores, as I have tried to show in fig. 16. Some of these banks were from fifteen to eighteen feet high, and this moss would reach to the water. I suppose the reason that it was more noticeable in open spaces was, that the trees and shrubs, and especially their roots, would, from undermining, carry the moss with their heavy weight into the water as they fell. For the first time the soil seemed to be thick and black; and grass, always good, was now really luxuriant for any climate. At camp 36 we found rosebuds large and sweet enough to eat. They were much larger than those at home, somewhat pear-shaped; and the increase in size is entirely in the fleshy capsule, while even the seeds seem to be less 'downy' and dry than those of temperate climes. During the night of the 22d–23d the river rose ten inches, all of which, I think, can be accounted for by the recent continued summer rains.

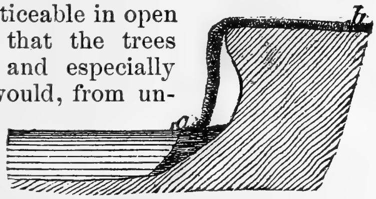


FIG. 16.

At 3.30 of the 23d we sighted Charlie's village, as it is called; but the current was so swift that we could not get the raft in so as to camp alongside, but made a sand-bar half a mile below. Charlie's village was an exact counterpart of that of Johnny's, even as to number of houses; and considering this, and the trouble to reach it, I did not attempt to photograph it. Attempting to reach it with the raft, so anxious were the Indians that we should be successful, that as many as could do so, put the bows of their canoes on the outer log of the raft, and paddled with such vehemence that it seemed as if life depended upon success. We found a Canadian voyager by the name of Jo Sadue among them, who, as a partner of one of the traders on the lower river, had drifted here in prospecting the stream for precious mineral. Jo, as he is known, speaks of the natives of both of these villages as Tadoosh, and says that they are the best-natured Indians from here to the mouth of the river.

On the 24th the country seemed to flatten out, the hills having lower grades; but the mountains well to the westward still had patches of snow on their sides near the summits. About half-past ten we saw a large buck moose swim from an island to the mainland just back of us, having probably, as a hunter would say, 'gotten our scent.' About two in the afternoon the river widened out to a great extent, and was full of islands. Starting from camp 38, the river, as the map shows, becomes one vast network of islands, the whole country as level as the great plains; and, as we entered it, our Chilcats seemed seriously to think that we were going out to sea; indeed, a person having no knowledge of the country might well think so. Here the mosquitoes were a little worse than in the hilly country, and the gnats most decidedly so. As we started out into this flat country, the mountains to the left (or west) still continued in a range that was thrown back at an angle from the river's course, and that ran out in a spur that was still continued by a series of peaks rising out of the flat land, and diminishing in size until they disappeared towards the north-north-west. I called them the Ratzel range, or peaks, after Professor Ratzel of Munich.

The 27th of July we made old Fort Yukon (now abandoned as a trading-station), and connected our surveys with those of Capt. Raymond's party in 1869, thus giving a survey the whole length of the river.

FRED'K SCHWATKA,
Lieut. U. S. army.

PROTECTION OF ALPINE PLANTS.

EVERY one interested in alpine plants will be glad to hear that a society for their protection has been formed at Geneva. Before this time, attempts have been made by the governments of several Swiss cantons to protect plants, especially the edelweiss; which, however, is not a rare plant, and needs protection less than a host of its scarcer neighbors. Spain and Italy have already taken steps toward protecting their alpine floras; and the latter country hopes to obtain an edict from the government, which shall authorize the collection of rare plants, only by persons supplied with cards of permission.

The new society was founded in January, 1883, under the title 'L'association pour la protection des plantes.' Its formation at Geneva is particularly fitting; for, besides possessing the typical alpine flora, this place is the northern, and also the southern, limit of many plants. Being the great business and social centre, it is frequented by venders of the plants; so that any action there would strike at the principal source of drain: and, from its associations as the home of past and present eminent botanists, it is very suitable.

The aim of the society will be to check the wholesale collection of plants (and it is thought that the best means to accomplish this is to call the attention of the public to the injury done by the collection of plants with roots); to develop a taste for the cultivation of alpines; and to induce gardeners to raise them, and sell them at a moderate price. These plans, especially the propagation in sale-gardens, have been approved by the Swiss and various other alpine clubs. Among the advocates of the plan of propagation is Alphonse de Candolle, who thinks that the action of the police and legal interference would merely raise the price of plants, and thus increase the incentive for their collection.

The custom of selling plants in the markets has not long been in vogue, yet long enough to show, that, unless effectually checked, the most injurious results will follow. It causes righteous indignation to all lovers of alpine plants to see the wholesale way in which, twice a week, the peasants (mostly the women) bring into Geneva and other markets these beautiful gems of the mountains, each in its season, — the rare rather than the commoner ones, as they naturally command a higher price. In fact, as has been said, one can make a botanical excursion without going out of the city. The flowers not sold soon fade and droop in the hot sun, and are thrown aside as worthless; rarely do purchasers keep them longer than while they are in bloom: and thus are thousands of plants, roots and all, destroyed.

In the second bulletin of the society, a botanist writes that the societies for exchange of botanical specimens also offer much danger to rare species. The members, he says, are mostly amateurs, and obtain for their herbariums foreign plants by giving specimens of the rare plants of their own country; and this, in time, absorbs an immense quantity of specimens. He himself once communicated with one of these societies in order to obtain some rare plants. In return, an exorbitant list of the scarcest kinds was demanded, the quantity being frequently expressed as '*un char plein*,' '*le plus possible*,' etc. Besides these sources of drain, collectors from horticultural houses in England and Germany carry away great numbers of plants; professors and their pupils freely help themselves to rare species; 'botanical guides' aid in the devastation by directing collectors to rich localities; and vast quantities are collected for pharmaceutical purposes, or are sold as botanical albums or as herbariums.

Many localities, formerly rich in specimens, are now nearly or quite stripped of them; and it is time that these plants, perhaps the most universally attractive and admired in the world, should be protected from the disastrous war annually made upon them.

The society has attempted to check this abuse by spreading a knowledge of the danger by means of correspondence and publications. It has been suggested to post placards in Swiss hotels, requesting visitors not to collect roots, and informing them where they can purchase the same plants cultivated, in much better condition for transportation and future cultivation.

A most important result of the work of the society is, that a horticultural company has been formed for the cultivation and sale of such alpine plants as may be induced to grow in the valleys. Mr. Correvin, formerly director of the botanic garden of Geneva, and at present secretary of the Society for protection of plants, has been made superintendent of the establishment. It will raise plants from seed principally; and they can be purchased in pots, ready for transportation. There is no cause to fear for the success of the enterprise if the financial part proves prosperous, as the most attractive species of alpine Primulas, Campanulas, Dianthuses, gentians, edelweiss, orchids, etc., have been successfully grown in Switzerland, in England, and some of them even in this country.

The new society now numbers some two hundred members, each of whom pays the small annual assessment of two francs. All persons are invited to join, and thus to assist this most worthy object, the expenses of which, especially in the way of publication, must be very considerable.

THE DEEP-SEA CRUSTACEA DREDGED BY THE TALISMAN.[1]

CRUSTACEA are distributed from the surface of the water to very great depths; and, at the exhibition of the Talisman collection, one may see Neptunus Sayi and Nautilograpsus minutus of the Sargasso, whose color they have assumed, side by side with other forms, as Ethusa alba, which is only found between four and five thousand metres below the surface. The swimming crustaceans, forming the group of Brachyura, are extremely rare at great depths. Certain forms of these crabs, taken on the Talisman, are remarkable for their geographical distribution, such as Bathynectes, found at four hundred and fifty and nine hundred and fifty metres, on the coasts of Morocco, and at the Cape Verde Islands, and which much resemble the Portunus of our coasts. On the other hand, they are very like species of the same genus, obtained at the Antilles, in the German ocean, and in the Mediterranean. The Oxyrhynchi, other triangular crustaceans of the group of Brachyura, are found lower than the last. Lispognatus Thompsoni was found between six hundred and fifteen hundred metres, on the Morocco coasts; and Scyramathia Carpenteri, in the same region, at twelve hundred metres. The former species had before been observed only in the German ocean; and the latter, north of Scotland and in the Mediterranean.

Crustaceans, intermediate in form between the brachyurans and macrurans, are found in abundance in deep water. They seem to belong to genera between the two; and, in studying Crustacea, it is surprising to see types, which, taken separately, appear absolutely distinct, brought into contact by these intermediate forms. Thus the genera Ethusa, Dorippe, Homola, and Dromia, are linked together by many forms, with blended characteristics, rendering them difficult to classify. Several of the crustaceans are remarkable for their geographical distribution. Thus, on the coasts of Morocco, there was found a species of Dicranomia, noticed by Edwards in the Caribbean; and Homola of Cuvier, considered

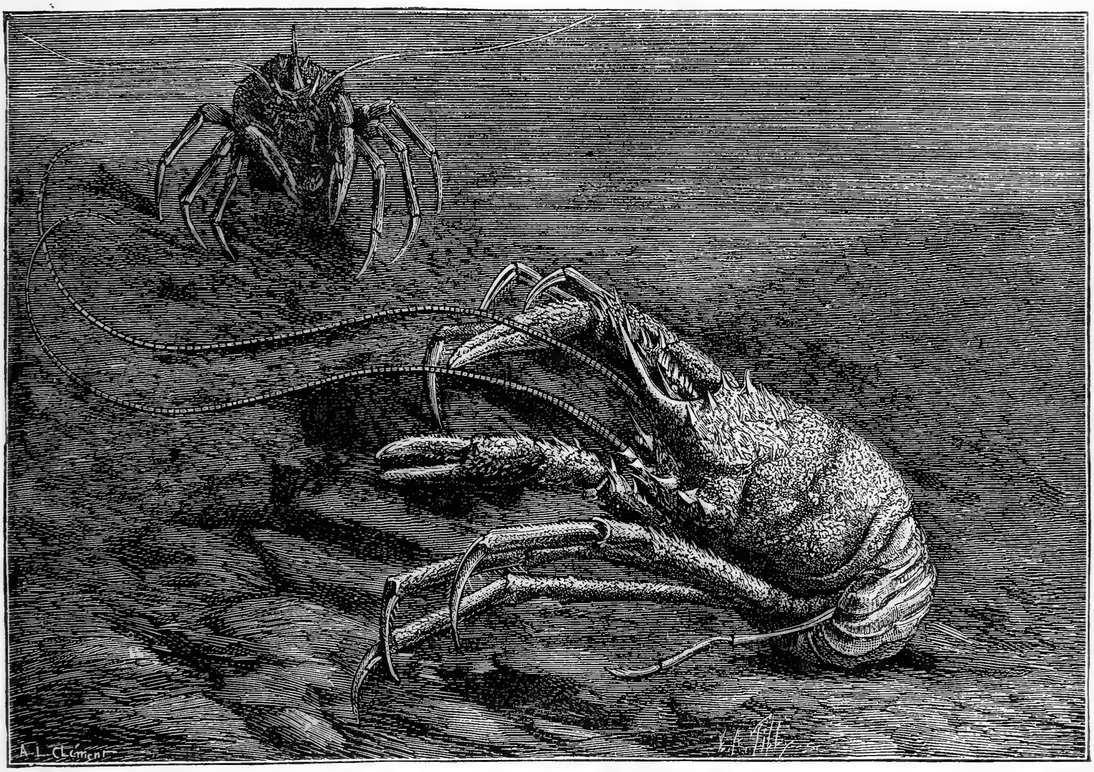


FIG. 1.—GALATHODES ANTONII, A BLIND CRUSTACEAN FROM A DEPTH OF 4,100 METRES. (NATURAL SIZE.)

[1] Translated from the French of H. FILHOL, in *La Nature*.

before as peculiar to the Mediterranean, was found extending from the coasts of Morocco to the Azores and the Canaries. But the most noticeable example of great geographical distribution is presented by Lithodes. These animals have hitherto been noticed only at the surface, in the waters of the poles. We found them at the tropics. But here, to meet the changed conditions of their surroundings, they have deserted their former depth for one of a thousand metres. This fact is important as bearing on the animal distribution of the oceans. It shows, first, that certain animal forms extend from northern seas to the tropics; and, next, that animals from the poles have only to seek deeper water in proportion as they approach the warmer regions, to reach a zone suited to their organization.

The Paguri, commonly called hermit-crabs, have been found at five thousand metres. The bodies of these animals are protected only at the head and thorax; and, to shield their abdomens, they lodge in shells whose size corresponds to their own. But, as the shells of deep water are always very small, the abyssal Paguri obtain only very imperfect protection. One of these species, obtained on the Morocco coast and in the Sargasso, presents a very singular habitat. It lodges, not in a shell, but in a regular animal colony formed by beautiful Epizoanthi. These Zoanthi originally developed in a shell which has been gradually re-absorbed; and it is the cavity corresponding to this which this peculiar species of hermit-crab now occupies.

Galatheans have been found abundant at all zones; and the color of the body, generally reddish, becomes white with those living at great depths. Certain species establish themselves as lodgers in the interior of those beautiful sponges, the Aphrocallistes, whose tissue resembles lace. Galathodes Antonii, a new species, a specimen of which was taken below four thousand metres, is here figured (fig. 1). Ptychogaster formosus (fig. 2) is interesting on account of the position of its abdomen, folded twice upon itself.

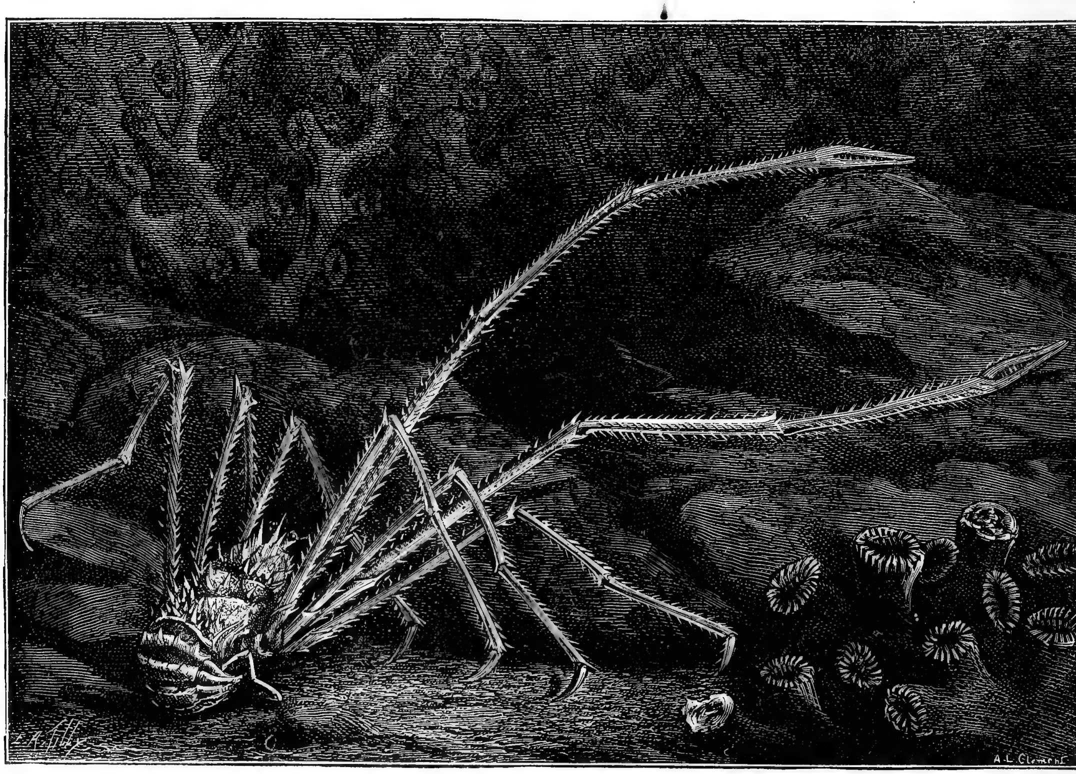


Fig. 2.— Ptychogaster formosus, dredged from a depth of 950 metres. (Natural size.)

The group of the Eryonides is represented by a number of species and genera. Polycheles and Willemoesia, whose tissues are so transparent that the stomach is visible through them, were taken at four and five thousand metres. The species of Pentacheles, common between one and two thousand metres, present forms very similar to those described in the fossil state, under the name of Eryon. At the exhibition of the Talisman collection, there is placed beside Pentacheles crucifer a calcareous plate coming from the Jurassic deposits of Solenhofen in

Bavaria, on which is the impression of an Eryon; and a comparison of these specimens impresses one with their great resemblance.

The macrurans, a group to which the crayfish belong, are abundant at all depths. At the Cape Verde Islands, at five hundred metres, a thousand individuals of a new species of Pendale were obtained. Among the most remarkable forms, I will mention a beautiful red Aristes, whose antennae are five or six times as long as the body; Nematocarcinus (fig. 3), whose claws are disproportionately long; Oplophorus; Notostomus, of a vivid red; Acantephyra; Pasiphae, sometimes brown, sometimes rose-colored, often covered with red spots; and Glyphus, one species of which, Glyphus marsupialis, has a very strange arrangement, the lateral plates of the first abdominal segment being developed in the female to form a pouch for the eggs. I will call

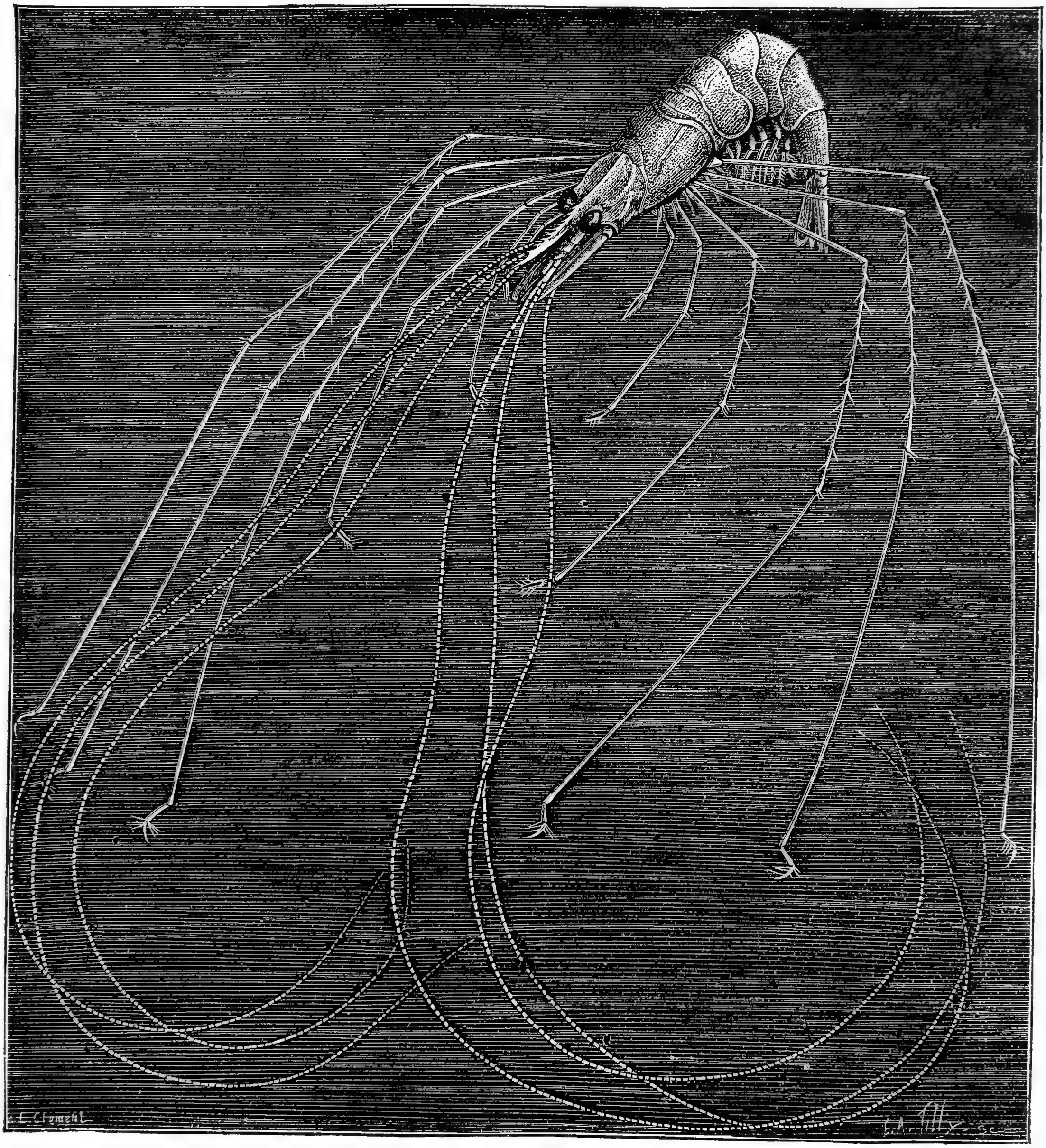


FIG. 3.—NEMATOCARCINUS GRACILIPES, TAKEN IN THE TRAWL AT A DEPTH OF 850 METRES. (NATURAL SIZE.)

attention, finally, among the schizopods, to Gnatauphausia, of large size, and of a scarlet color. The lower crustaceans, Amphipoda and Isopoda, were found in large numbers; but a study of them is much less interesting than that of the forms of which we have just spoken. The species of Nymphon is abundant at great depths; and a giant form, whose stomach extends to the end of its claws, Colossendeis titan, was taken at four thousand metres.

With crustaceans, as with fishes, it is very interesting to inquire whether the circumstances surrounding them cause modifications and adaptations in their organisms. The changes in the tissues are often noticeable in the structure of the carapace and muscles. I have already called attention to Pentacheles, Polycheles, and Willemoesia, whose tissues are so transparent as to allow the viscera to be seen; and the flesh is tender, and lacking flavor. The exterior colors are either a bright red, a rose-white, or a pure white. The macruran Crustacea are specially noticeable for their brilliant colors: and one cannot restrain a feeling of admiration for Aristes, of a carmine color; Notostomus, of a pure, deep red; and Pasiphae, spotted red and white. At very great depths, rose-white or pure white are the only tints observed.

With the fishes, as we have seen, the visual organs are always well developed, at whatever depth these animals are taken. It is not so with the Crustacea, several species of quite different groups having experienced atrophy, and sometimes a complete disappearance of the eyes. It is, however, a very singular fact, that some species in the same genus are blind, and others are not. Thus Ethusa granulata, living in the German ocean, between two hundred and thirteen hundred metres, is blind; while Ethusa alba, taken in the Atlantic, at five thousand metres, is not blind. The disappearance of the eyes seems to be gradual, and to be related to the depth at which the animal lives. The cornea first disappears, the ocular stalk remaining, and being movable. Then these parts become fixed, and, losing their characters, are changed into spines. Thus, says Norman, "Ethusa granulata, dredged between one hundred and ten and three hundred and seventy fathoms, has two remarkable ocular stalks, smooth and rounded at the extremity, where ordinarily the eyes are placed. With the specimens from the north, living at a depth of from five hundred and forty-two to seven hundred and five fathoms, the ocular stalks are no longer movable: they become fixed in the sockets, and their function is changed. Their dimensions are much enlarged; they approach their foundation; and, instead of being rounded, they end in a very firm rostrum. No longer serving as eyes, they serve as rostra." We have on exhibition one blind species, Galathodes Antonii (fig. 1), taken on the Talisman; and near this strange form, whose eyes are replaced by sharp spines, may be seen Pentacheles, Polycheles, Willemoesia, and Cymonomus, whose eyes are more or less changed.

Crustaceans of great depths emit phosphorescence. The light is shed, sometimes by the whole surface of the body, and sometimes, as with Aristes, in a special manner, by the eyes themselves. With some of them it seems as if there were, in certain parts of the body, organs arranged for the production of this light, — a fact which recalls what was said about fishes. Thus in Acantephyra pellucida, a new species, the claws are furnished with phosphorescent bands. The organs of touch are considerably developed, the most remarkable example of which is found in the long antennae of Aristes. With certain crustaceans, as in Benthesisymnus, the last pair of claws assume the character of antennae, and have the same function, probably, as these organs.

THE WOBURN ROTATION EXPERIMENTS.

For the past six years some very interesting field-experiments have been in progress at Woburn, Eng., under the conduct of Dr. Voelcker, chemist of the Royal agricultural society. A portion of these experiments are upon the continuous growth of wheat and barley on the same land, and closely resemble the celebrated Rothamsted experiments, differing from them in being made upon light land. Other of the experiments are rotation experiments, and are designed to test the comparative agricultural value of artificial fertilizers, and of barnyard-manure made from different feeding-stuffs. These experiments are to be continued for a series of years; but a brief description of their plan, and a statement of the results obtained up to the present time, may not be without interest.

The rotation is an ordinary four-course rotation; viz., roots, barley, grass, and wheat. Sixteen acres are under experiment; so that, in any given year, four acres are covered by each crop, while, in the course of four years, each plot of four acres bears successively the crops above enumerated. The following table shows at one view the crops thus far carried by each plot:—

Date.	Plot 1.	Plot 2.	Plot 3.	Plot 4.
1877	Grass	Roots	–	–
1878	Wheat	Barley	Grass	Roots
1879	Roots	Grass	Wheat	Barley
1880	Barley	Wheat	Roots	Grass
1881	Grass	Roots	Barley	Wheat
1882	Wheat	Barley	Grass	Roots
1883	Roots	Grass	Wheat	Barley

Each plot of four acres is subdivided into four one-acre sections, and these are fertilized in different ways. As each of the four plots is treated exactly alike in successive years, it will suffice to follow one plot through the four years, in order to understand how each section of it is fertilized. Plot No. 1 was in grass in 1877, the grass being a mixture of clover and rye-grass. Sheep were pastured on each of the four sections of this plot sufficient to consume the grass. To the sheep on the first section were given 728 pounds of decorticated cottonseed-meal, and to

those on the second section the same weight of corn-meal, while on the third and fourth sections the sheep had only the grass. The droppings of the animals were left on the land; and, as fattening animals retain practically none of the fertilizing ingredients of their food, these droppings were richer on the first and second sections by the amount of plant-food contained in the cottonseed-meal and corn-meal respectively. In the fall the land was sown to wheat; and in the spring, sections 3 and 4, on which no ground-feed was fed, were top-dressed with commercial fertilizers. Section 3 received fertilizers containing amounts of nitrogen and mineral ingredients equal to the nitrogen and ash of the 728 pounds of cottonseed-meal fed on section 1; and section 4, in the same way, received nitrogen and ash equal to the amounts contained in the 728 pounds of corn-meal fed on section 2.

Thus the four sections of this plot permitted a comparison of the relative value for the wheat-crop, first, of stable-manure made from corn-meal and cottonseed-meal respectively, and, second, between the value of stable-manure and a quantity of commercial fertilizers containing the same amounts of plant-food. Following the wheat, mangolds were grown in 1879, variously manured on the four sections. On section 1 they received stable-manure made from 1,728 pounds of straw as litter, 5,000 pounds of mangolds, 1,250 pounds of wheat-straw, and 1,000 pounds of cottonseed-meal; on section 2, stable-manure made from the same amounts of food and litter, except that 1,000 pounds of corn-meal were substituted for 1,000 pounds of cottonseed-meal. On plot 3 they received stable-manure made from the same quantities of roots and coarse feed as were mentioned above, but without either cottonseed- or maize-meal, and, in addition to this stable-manure, commercial fertilizers equivalent to all the ash, and two-thirds of the nitrogen, of 1,000 pounds of cottonseed-meal. On plot 4 they received the same stable-manure as on plot 3, and, in addition, chemicals equivalent to the ash and nitrogen of 1,000 pounds of corn-meal.

Here, again, we have a comparison of stable-manure from different fodders with equivalent amounts of concentrated fertilizers. The stable-manure, in this case, was made by steers which were fed in so-called feeding-boxes, in which all the excrements and litter were retained, and compacted by the movements of the animal.

The mangolds produced on each section were weighed, and then fed out to sheep on the land. Following the mangolds came, in 1880, barley. This received no manure but the droppings of the sheep to which the mangolds were fed, except that section 2 received the remaining third of the nitrogen of 1,000 pounds of cottonseed-meal in the form of a top-dressing of nitrate of soda.

In 1881 the barley was followed by grass, to be fed off by sheep as described, thus beginning the rotation anew.

It will be seen, that, in the course of the four years' rotation, each plot furnishes three tests, with as many crops, of the manurial value of cottonseed-meal as compared with maize-meal, and of each as compared with an equivalent amount of concentrated fertilizers. Moreover, since each one of the four plots is treated alike, three such comparisons can be made each year in different plots. Thus, by continuing the experiments for a series of years, it will be possible to eliminate from the results, to a certain extent, the errors which may arise from unequal quality of the soil on the different sections, and also to judge how the character of the season affects the action of the manures.

The subject is a very interesting one, and one which has received comparatively little attention experimentally. We know, indeed, with sufficient accuracy, the relations between the composition of food and that of the manure made from it. We know that in the manure of working, and of mature fattening animals, is found practically all the plant-food which their fodder contained. We know, that, in the case of growing animals and of those giving milk, more or less of the elements of plant-food pass into the new growth, or into the milk, and are lost to the manure; and we know approximately what proportions of them are thus lost on the average. With the necessary data as to amount and kind of food consumed, it is a comparatively easy task to compute the amount of valuable matters contained in the manure produced; but as to what modification the agricultural value of these matters may have undergone, and how it compares with the various forms of artificial fertilizers, we are comparatively ignorant. For example: we know that practically all the phosphoric acid of the food of a fattening animal passes into the excreta; but how the manurial value of this phosphoric acid compares with that of the soluble, the reverted, or the insoluble phosphoric acid of a superphosphate, with that of raw bone, or of native phosphates, can be, at best, only conjectured.

The Woburn rotation experiments promise to contribute to the solution of some of these questions. It would be premature to seek to draw definite conclusions from the results thus far obtained; for only a considerable length of time can enable us to estimate the effect of *continuous* treatment, of the sort described, upon the yield of the several crops. At the same time, a brief statement of them may furnish some interesting suggestions.

The following table contains the results, up to 1882, in pounds per acre, of the experiments on mangolds, barley, and wheat. Under the head of manuring are included only the amounts of cottonseed- or corn-meal fed to the sheep, or their equivalents in commercial fertilizers. It should be understood that this was not all the manure used, as will be evident on comparing the detailed description of a rotation given above.

In interpreting these results, there are some things which should be borne in mind. In the first place, we find in the reports of the above experiments, in the *Journal of the Royal agricultural society*, very meagre details as to their conduct. It is to be supposed that all four of the sections in each plot were

Results of Woburn rotation experiments.

MANGOLDS.

Sect.	Manuring.	1877 — Plot No. 2.			1878 — Plot No. 4.			1879 — Plot No. 1.			1880 — Plot No. 3.			1881 — Plot No. 2.		
		Roots.	Tops.	Total.	Roots.	Tops.	Total.	Roots.	Tops.	Total.	Roots.	Tops.	Total.	Roots.	Tops.	Total.
1	1000 lbs. cottonseed-meal	6,920	4,650	11,510	29,475	6,025	35,500	10,033	4,739	14,772	43,820	8,345	52,165	50,023	8,024	58,047
2	1000 lbs. maize-meal . .	4,625	3,925	8,550	26,350	6,021	32,371	9,993	4,617	14,610	34,231	7,416	41,647	48,667	7,965	56,632
3	Ash and $\frac{2}{3}$ of nitrogen of cottonseed-meal . .	16,188	7,575	23,763	40,820	8,125	48,945	17,676	6,433	24,109	55,050	8,306	63,356	54,718	9,100	63,818
4	Ash and nitrogen of maize-meal	8,400	5,650	14,050	28,537	7,130	35,667	12,847	4,875	17,722	46,838	7,420	54,258	48,600	8,356	56,956

BARLEY, AFTER MANGOLDS FED ON THE LAND.

Sect.	Manuring.	1878 — Plot No. 2.			1879 — Plot No. 4.			1880 — Plot No. 1.			1881 — Plot No. 3.		
		Grain.	Straw.	Total.	Grain.	Straw.	Total.	Grain.	Straw.	Total.	Grain.	Straw.	Total.
1	No fertilizers	2,008	3,132	5,140	1,781	2,966	4,747	1,947	2,782	4,729	2,256	3,067	5,323
2	No fertilizers	1,880	3,165	5,045	1,912	3,180	5,092	1,717	2,698	4,415	2,136	2,952	5,088
3	Nitrate of soda, containing $\frac{1}{3}$ the nitrogen of 1000 lbs. cottonseed-meal	2,291	3,825	6,116	2,085	3,132	5,217	1,897	2,989	4,886	2,267	3,158	5,425
4	No fertilizers	1,750	3,195	4,945	1,543	2,624	4,167	1,575	2,480	4,055	2,316	2,827	5,143

WHEAT, AFTER GRASS FED ON THE LAND.

Sect.	Manuring.	1878 — Plot No. 1.		
		Grain.	Straw.	Total.
1	728 lbs. cottonseed-meal	2,177	4,874	7,051
2	728 lbs. maize-meal	2,304	4,623	6,927
3	Fertilizers containing ash and nitrogen of 728 lbs. cottonseed-meal	2,686	6,376	9,052
4	Fertilizers containing ash and nitrogen of 728 lbs. maize-meal	2,118	5,479	7,597

Sect.	Manuring.	1879 — Plot No. 3.			1880 — Plot No. 2.			1881 — Plot No. 4.		
		Grain.	Straw.	Total.	Grain.	Straw.	Total.	Grain.	Straw.	Total.
1	672 lbs. cottonseed-meal	1,884	5,793	7,677	1,033	3,676	4,709	2,997	4,700	7,697
2	728 lbs. maize-meal	1,931	5,991	7,922	1,201	4,100	5,301	3,077	4,717	7,794
3	Fertilizers equivalent to 672 lbs. cottonseed-meal	2,034	7,168	9,202	999	4,218	5,217	3,114	5,369	8,483
4	Fertilizers equivalent to 728 lbs. maize-meal . .	2,022	6,377	8,399	1,116	3,976	5,092	2,943	5,149	8,092

cultivated, seeded, and otherwise treated, exactly alike; but no mention is made of the means adopted to secure accuracy in these respects. We are not told whether the composition of the fodders and fertilizers used was actually determined by analysis, or whether average composition was assumed for them. We have no comparison of the crops on the several sections as to the proportion of water they contained when weighed. Above all, we have no proof of the uniform quality of the land, and no knowledge of its natural capacity, as neither unmanured plots nor duplicate manurings were employed.

Under these circumstances, it is evident that no great weight can be given to small differences of yield, or to single results. On the other hand, a result which is repeated year after year, or which is very striking in amount, may serve as the basis of at least tentative conclusions.

Taking first the results on mangolds, we find, that, in every case, the manuring with cottonseed-meal was followed by a larger crop than was that with corn-meal; further, that in every case the fertilizers equivalent to the cottonseed-meal were followed by a larger crop than were those equivalent to the corn-meal; finally, that in every case but one (1881 — Plots 2 and 4) the commercial fertilizers were followed by a heavier crop than was the corresponding stable-manure.

Taking next the barley, and taking the figures as they stand, in three cases out of four the manuring with cottonseed-meal was followed by a larger yield, both of grain and of total crop, than was that with corn-meal.

In three cases out of four the grain, and in every case the total crop, were greater after the fertilizers equivalent to the cottonseed-meal than after those

equivalent to the corn-meal. In four cases out of eight the fertilizers were followed by a heavier crop than was the stable-manure. Many of the differences, however, are comparatively small.

In the wheat experiments the corn-meal manure proved superior to the cottonseed manure in every case as regards grain, and in three out of four cases as regards total yield. The fertilizers equivalent to the cottonseed-meal proved superior to those equivalent to the corn-meal in three cases out of four as regards grain, and in every case as regards total yield. The fertilizers surpassed the corresponding stable-manure in seven cases out of eight as regards total yield, while as regards grain the proportion is four to four.

Some of these results are quite different from those which we should have expected. Cottonseed-meal of good quality contains more than two and a quarter times as much nitrogen, four and a half times as much phosphoric acid, and four times as much potash, as corn-meal, and consequently the manure made from the former in these experiments must have been much the richer. The greater growth of the mangolds on the cottonseed sections accords with this fact, while the still greater effect of the commercial fertilizers corresponds with their greater solubility and consequent prompter action. With the barley and wheat, these results are far less marked. With the barley, they are mostly the same in kind. With the wheat, cottonseed-meal was excelled by corn-meal as a manure-producer, while otherwise the results were in the main the same as with the other crops.

A more careful examination, however, shows that the differences, both as to barley and wheat, are too small to be of very much significance. The greatest difference of yield of grain between the corn-meal and cottonseed sections was, in the case of barley, two hundred and thirty pounds per acre, equal to about five bushels, and, in the case of wheat, a hundred and sixty-eight pounds per acre, equal to less than three bushels. The differences in the total yield (grain and straw) are correspondingly small. It is certainly questionable, whether these differences are not less than the errors of experiment; and the only safe conclusion which we can draw is, that the yield was not greatly different in the two cases.

The commercial fertilizers showed greater differences; the richer manuring, containing the equivalent of the cottonseed-meal, generally proving decidedly superior, particularly as regards the total yield, the grain being not so much affected.

As compared with the stable-manures, the fertilizers show but a slightly larger yield of wheat. The barley, it must be remembered, received no manure or fertilizers directly, except a light top-dressing of nitrate of soda on section 3, but only the droppings of the sheep fed on the mangolds of the preceding year.

It is not the purpose of this article to theorize as to the reasons of the results obtained in these experiments, and such theorizing would be premature at present. One thing is shown very plainly by them, however; and that is, that, in all discussion of methods and systems of fertilizing the soil, two aspects of the question must be clearly distinguished. We may regard manures either as direct sources of food to the plant, or as means of enriching the soil, and accordingly distinguish between the immediate returns which they yield, and their value as an investment. In these experiments there can be no doubt that the cottonseed sections received more plant-food than the corn-meal sections in every case, and we have no reason to suppose that this plant-food would not all become available at some time; but the immediate returns were not always greater. In the comparatively short time during which the experiments have been in progress, it has been the immediate value of the manures and fertilizers used which has manifested itself.

Whether, after a number of years, the richer manuring will not show better results on the grain-plots, is a question which, *a priori*, would receive an affirmative answer; and the testimony of experiment on this point will be awaited with interest.

H. P. ARMSBY.

THE AMERICAN FISH-CULTURAL ASSOCIATION.

THE annual meeting of this association was held in the lecture-room of the National museum at Washington, on May 13, 14, and 15. President Benkard made an address of welcome, and briefly reviewed the work of the association for the past year.

Many papers were read, and the attendance was good throughout. Mr. F. Mather gave an account of the hatching-work at Cold Spring Harbor, stating that the eggs of the tom-cod had been successfully hatched there this spring.

Prof. H. J. Rice related his experiments with various substances used to destroy the Saprolegnia, the fungus which attacks fishes in aquaria. The most successful results were obtained by the use of a bath of common salt. Fishes which were badly infested with the fungus, after immersion in a moderately diluted solution of salt and water for a minute or so, after a while had the adherent film of fungus loosened in large flakes. This method, if applied in time, would prove effectual, if one were afterwards careful not to introduce into the aquarium organic material which would decompose, and afford a nidus for the nourishment and multiplication of this pest from its spores.

Mr. L. Stone read a paper on the artificial propagation of salmon in the Columbia-River basin, taking the ground that it was probably now too late to begin propagating these fishes in some of the most depleted branches of the Columbia.

Mr. C. G. Atkins gave some important data respecting the rate of growth, and facts regarding the habits of land-locked salmon. In reply to questions by Mr. G. B. Goode, the speaker thought that the land-locked salmon did not hybridize with the common salmon under natural conditions; nor did he think that there was evidence at present to prove that the

land-locked salmon had descended from the sea-salmon, though the latter was probably the ancestor of the former.

Dr. W. M. Hudson, of the Connecticut shell-fisheries commission, gave an interesting account of the great work in progress in extending the area of the oyster-beds in the waters of Connecticut by sowing shells, together with a small proportion of live oysters, over the bottom, in waters not before productive. The statistics presented by the author showed that this industry had developed within a very short period to amazing proportions in his state, mainly through the enlightened administration of the commissioners, and the enactment of good protective laws by the state legislature. The speaker also gave a synopsis of the laws regulating the ownership of the beds, which he said were working admirably, and concluded by saying that the worst enemies of the oyster in his state were the star-fishes and human poachers, being undecided in his own mind which of the two was the worse. Steps were being taken to have all the star-fishes which are dredged destroyed.

Lieut. Francis Winslow, U.S.N., read a long paper on the present condition and future prospects of the oyster-industry, in which he showed that the beds of Virginia and Maryland were being depleted by excessive dredging, and commended reparative measures, such as were in successful operation in the waters of Connecticut. His paper was illustrated by a large and important series of charts, upon which were mapped almost all of the oyster-beds of the eastern coast of the United States, showing the depth of water in which the beds lie, and, as far as possible, their present condition.

Mr. G. Brown Goode presented a paper on the oyster-industry of the world, which is seated chiefly in the United States and France. Great Britain has still a few natural beds remaining, and a number of well-conducted establishments for oyster-culture. Canada, Holland, Italy, Germany, Belgium, Spain, Portugal, Denmark, Norway, and Russia have also oyster-industries, which are comparatively insignificant, and, in the case of the last two countries, hardly worthy of consideration in a statistical statement.

Recent and accurate statistics are lacking, except in two or three instances. A brief review by countries, in the order of their importance, was presented. The oyster-industry of the United States was shown to employ 52,805 persons, and to yield 22,195,370 bushels, worth $30,438,852; and that of France, in 1881, employed 29,431 persons, producing oysters valued at $3,464,565; the industry of Great Britain yielded a product valued at from two to four millions of pounds sterling; Holland was shown to have a considerable industry in the province of Zealand, and to have produced native and cultivated oysters to the value of $200,000; Germany has an industry on the Schleswig coast valued at about $40,000; while the products of other European countries mentioned was too insignificant to deserve a place in this brief abstract. An estimate of the total product of the world was presented as follows, the figures being given in the number of individual oysters produced:—

Countries.	No. of oysters.
United States [1]	5,550,000,000
Canada	22,000,000
Total for North America	5,572,000,000
France	680,400,000
Great Britain	1,600,000,000
Holland	21,800,000
Italy	20,000,000
Germany	4,000,000
Belgium	2,500,000
Spain	1,000,000
Portugal	800,000
Denmark	200,000
Russia	250,000
Norway	250,000
Total for Europe	2,331,200,000

The oyster-industry is rapidly passing from the hands of the fishermen into those of oyster-culturists. The oyster, being sedentary except for a few days in the earliest stages of its existence, is easily exterminated in any given locality; since, although it may not be possible for the fishermen to rake up from the bottom every individual, wholesale methods of capture soon result in covering up, or otherwise destroying, the oyster banks or reefs, as the communities of oysters are technically termed. The main difference between the oyster-industry of America and that of Europe lies in the fact, that in Europe the native beds have long since been practically destroyed, perhaps not more than six or seven per cent of the oysters of Europe passing from the native beds directly into the hands of the consumer. It is probable that sixty to seventy-five per cent are reared from the seed in artificial parks, the remainder having been laid down for a time to increase in size and flavor in shoal waters along the coasts. In the United States, on the other hand, from thirty to forty per cent are carried from the native beds directly to market. The oyster-fishery is everywhere carried on in the most reckless manner; and in all directions oyster-grounds are becoming deteriorated, and in some cases have been entirely destroyed. It remains to be seen whether the governments of the states will regulate the oyster-fishery before it is too late, or will permit the destruction of these vast reservoirs of food. At present the oyster is one of the cheapest articles of diet in the United States; while in England, as has been well said, an oyster is usually worth as much as, or more than, a new-laid egg. It can hardly be expected that the price of American oysters will always remain so low; but, taking into consideration the great wealth of the natural beds along the entire Atlantic coast, it seems certain that a moderate amount of protection will keep the price of seed-oysters far below European rates, and that the immense stretches of submerged land especially suited for oyster-planting may be utilized, and made to produce an abundant harvest at much less cost than that which accompanies the complicated system of culture in France and Holland.

Mr. J. A. Ryder thought that purely artificial

[1] On the basis of 250 oysters to the bushel.

methods, applied to the propagation of the oyster, were not as unpromising as some seemed to suppose. This much, at least, was certain, — that a simple method of confining the fry so as to prevent its escape from partially land-locked waters was practicable, and would doubtless be found to be a valuable aid in oyster-culture in the future.

Mr. George S. Page read a paper on the success with which certain lakes in Maine had been stocked with black bass from fish taken from New York.

A paper was then read by Col. M. McDonald on the natural causes influencing the movements of fishes; the author remarking, that in aquaculture, as in agriculture, a number of conditions necessarily concur in determining production. Many of the conditions are capable of being modified by man's agency. His influence in determining increased production, either on the land or in the water, is measured by the increase in average production, which he may effect by modifying favorably the natural conditions which are under his control.

The most important condition determining the fluctuations in the aggregate number of fish taken year by year is the temperature of the medium in which they live. In the case of the shad (Alosa sapidissima), the study of records of water-temperature would seem to indicate that it is ever moving, in its ordinary migrations, towards a temperature of 60°. Assuming this to be true, we should expect in an area like the Chesapeake, limited and bounded seaward by a wall of low temperature, always to find the shad in that portion of this area which approximated more nearly to 60°. To trace the shad in their migrations, it is only necessary to determine the shifting of this area of congenial temperature under the influence of the seasons. Our temperature records for 1881, 1882, and 1883, indicate, that, for the winter months, the area of maximum temperature is not in the rivers, nor in the bay, but on the ocean plateau outside, extending from the capes of the Chesapeake to the Delaware Breakwater. The presumption, therefore, is, that the schools of shad belonging both to the Chesapeake and the Delaware have their common winter quarters on this plateau. When, under the influence of the advancing seasons, the waters of the Chesapeake and the Delaware bays become warmer than those of this plateau, the migration into continental waters begins. The proportion of the run that will be directed to the Delaware or to the Chesapeake will be determined at this early period. If the water at the northern end of this area warms up more rapidly than at the southern, then an undue proportion of the shad will be thrown into the Delaware. On the other hand, cold waters coming down the Delaware may effect the contrary movement, and throw the schools almost entirely into the Chesapeake; thus leading to a partial or total failure of the shad-fisheries of the Delaware for the season.

When the schools of shad have entered the Chesapeake, their distribution to the rivers will be determined in the same way by temperature influences. If the season is backward, so as to keep down the temperature of the larger rivers which rise in the mountains, then the run of shad will be mainly into the shorter tributaries of the bay, which have their rise in the tide-water belt, and, of course, are warmer at this season than the main rivers. Again: warm rains at the beginning of the fishing-season, and the absence of snow in the mountains, will determine the main movement of the shad into the larger rivers of the basin; and if, when the schools enter the estuaries of these rivers, they encounter a temperature considerably higher than that in the bay itself, the movement up the river will be tumultuous, the schools of shad and herring all entering and ascending at once, producing a glut in the fisheries, such as we sometimes have recorded.

We see, therefore, in the light of these facts, that we may have a successful fishing-season on the Delaware, accompanied by a total or partial failure in the Chesapeake area, and *vice versa;* and, considering the Chesapeake area alone, we may have a very successful fishery in the aggregate, yet accompanied by partial or total failures in particular streams, under the influence of temperature conditions. If statistics of the shad-fisheries are to furnish a measure of increase or decrease, they must include the aggregate catch of the Chesapeake and Delaware River, and, indeed, of rivers much farther to the north. Statistics based upon a comparison of the catch in the same river, in different seasons, are of no value as serving to give a measure of the results of artificial propagation.

That the aggregate production of the shad-fisheries of the Atlantic coast is on the increase, is shown by the fact, that, in the face of an ever-increasing demand, prices have not only been held at what they were in 1879, but have been sensibly reduced.

Mr. J. A. Ryder made a communication upon some of the forces which limit or determine the survival of fish embryos, remarking that different species of fishes differed very widely in respect to the number of ova produced by a single female during one season. After a comparison of the habits of the different forms, and after some attention had been bestowed upon the contrivances intended for the protection of the eggs and young which are developed by the parent fishes of certain species, as well as the protective adaptations developed by different ova, the speaker had concluded that the number of survivals out of any given brood of eggs was dependent upon the amount of such natural protection afforded them; that such a protective influence likewise tended to diminish the number of ova produced by a species during a single season just in proportion as such natural protective agencies were most effectual. This view the speaker thought was strongly supported by what is known of such species as commit their eggs to the mercy of the environment, as in the case of cod, with its two to nine millions of eggs left to float and hatch on the surface of the ocean; in which case a very small percentage of germs ever reach adult age, whereas every one of the six to twenty-five eggs of a viviparous or nest-building species grows at least large enough to begin the struggle for existence with

the environment, under circumstances a hundred-fold more favorable to their survival than the young of a totally unprotected form, or one only partially protected from immediate destruction by the buoyancy of its germs or ova.

The natural limitations of the supply and proper kinds of food were also alluded to, and some of the early imperfections of fish embryos pointed out, some having an imperforate oesophagus at the time of hatching, so that at this time they cannot take food. The relative strength of the embryos of different species at the time of leaving the egg was also shown to be dissimilar in the cases of those species which do not protect their broods; and it was suggested that such absence or presence of embryonic vigor might have an influence in diminishing or increasing the chances of survival.

The point, however, which the speaker wished especially to insist upon, was, that, other things being equal, it was probably true that the number of survivals out of a brood of eggs stood in nearly an inverse proportion to the number of germs actually produced, and that natural or adaptive protective agencies tended to diminish the fecundity of a species, just as a want of such protective endowments tended to increase fertility in order, apparently, to compensate for the wholesale destruction of such germs during their early and critical stages of development.

Dr. Theodore Gill, commenting upon Mr. Ryder's remarks, said that the facts just reported afforded a broad inductive basis for the doctrine, that, in proportion as the eggs of a species of fish were protected by the parents, just in that proportion were the chances of survival of the individual young increased, and the number of eggs correspondingly diminished. The speaker thought that it was not generally understood that many fishes were in the habit of caring more or less for their young, and that this ignorance was due to the fact that very few of the well-known fishes of Europe had such habits; and our popular writers, who draw so largely from European literature upon such subjects, failed to appreciate how frequently such was the case with our native forms. Citing the case of certain marine cat-fishes which hatch their young in the mouth, besides others which carry their ova upon processes on the abdomen, the speaker desired especially to call attention to the fact that about two-thirds of the sharks and rays, or elasmobranchs, were viviparous; the young undergoing their embryonic development within the body of the parent.

Mr. E. G. Blackford of New York read a paper entitled 'Is legislation necessary for the protection of the ocean-fisheries?' Judging from his own experience and observation for many years past as a dealer, he would hesitate regarding the expediency of legislative interference with the ocean-fisheries; which opinion he illustrated by statistics, and concluded by saying that probably the only fishery-products of which the supply had been perceptibly diminished by over-fishing, during the last fifteen years, were the striped bass, or rock-fish, and the lobster.

Mr. Joseph Willcox gave an account of his observations upon the sponge fauna and fisheries of the shallow waters of the west coast of Florida, north of Tampa Bay. About thirty species of fibrous, calcareous, and siliceous sponges were collected by him in this region; and he suggested, that, in view of the fact that fishing for the valuable fibrous or ceratose sponges of commerce was becoming less remunerative, steps ought to be taken to artificially propagate such forms as were of economical value.

Prof. W. O. Atwater of Middletown, Conn., gave a very interesting *résumé* of his investigations upon the subject of the chemical composition and nutritive value of American food-fishes and invertebrates. These investigations were directed to the determination of the percentages of proteids, carbohydrates, water, and refuse, contained in flesh-foods of different kinds: the results were carefully tabulated, and afford important data for the determination of the relative values of different fishes and mollusks as compared with other meats. Some of the results arrived at are quite remarkable: for example, a hundred pounds of oysters were found to contain very little more proteine than the same weight of milk, when the waste (that is, the shells) of the oysters was considered in the analysis. When the edible portion alone was analyzed, the nutrient matters contained in the oyster were found nearly in the same quantity as in codfish from which the head and entrails had been removed. The actual cost of the proteine consumed as food, it was shown, varied between very wide limits: for example, if consumed in the form of salmon early in the season, at one dollar per pound, the cost of proteine to the consumer was at the rate of five dollars and seventy-two cents per pound. If consumed in the form of the alewife, at three cents per pound, the actual cost of the proteine per pound was only nineteen cents. The nutritive value of different fishes was also found to vary considerably; that is to say, the percentage of proteine and carbohydrates is variable in quantity in different species. Thus, the percentage of available food-materials in the whole flounder is only five and three-tenths per cent, while in fat mackerel it is twenty-four and two-tenths per cent.

The presence of only a small percentage of carbohydrates in fish-food was noted, in which respect it contrasts strongly with fat pork and beef, which are rich in proteine and carbohydrates, and with farinaceous foods, which are poor in proteine; indicating, that, as an adjunct to these, fish-foods have a high value in all dietaries.

Mr. Richard Rathbun presented a paper on the decrease in the abundance of lobsters, briefly stating his conclusions regarding the supposed decrease in their number, based upon materials gathered from many sources in the interest of the tenth census, and still unpublished.

The lobster-fishery, as a separate and distinct industry, was first started about the beginning of the present century, on the coasts of Massachusetts and Connecticut, and only as late as 1840 on the coast of Maine, where it has since attained its greatest development. The vicinity of Provincetown, Cape Cod,

was at one time, about twenty-five to fifty years ago, the principal source of supply for the larger markets of the country, and especially for New-York City; and the trade between these two places was of great importance. The Cape-Cod grounds are now, however, so nearly depleted that the annual catch is of very slight value. Other important areas have shown indications of a similar decrease; and the market supplies have been increased from year to year only through a great extension seaward of the fishing-grounds, and the much greater number of traps used. A suggestive indication of the decrease in abundance of lobsters is furnished by the marked decrease in the average size of those now taken to supply the trade.

The fact was noted that the lobster is not a truly migratory species, but simply moves into slightly deeper water on the approach of cold weather, to return again to the same shallow areas as the spring advances. Continued over-fishing in any one region will therefore tend to reduce the stock of lobsters in that region, without the probability of its being rapidly replenished by migrations from a neighboring region; and the greater or less depletion of many areas may be explained in that way.

The solution of the problem as to how the fishery may be protected in the interests of the fishermen and the trade must be reserved for future investigations; but existing laws do not appear to give the desired benefits.

On Tuesday evening the association met in the hall of the National museum, to listen to an address by Hon. Theodore Lyman of Massachusetts, who reviewed the work of the U. S. fish-commission and of the state commissions in an able manner.

Hon. Theodore Lyman was elected president of the society for the ensuing year; and during the return trip from the river-excursion on the steamer Fishhawk, the name of the association was, after considerable discussion by the members present, changed to the 'American fisheries society.' A conference of all of the state fish-commissioners present at the meeting, with the U. S. commissioner of fish and fisheries, Professor Baird, was held on the 15th.

MEETING OF MECHANICAL ENGINEERS AT PITTSBURGH.

THE meeting of the American society of mechanical engineers at Pittsburgh, May 20–24, was in many respects one of the most interesting that has been held. The attendance was as good as usual, say twenty-five per cent of the membership, and the quality of the papers above the average. The arrangements for the social comfort and enjoyment of the guests were not, however, so complete as at the last spring meeting. It was a mistake, that the announcement of a *conversazione* and social re-union was not carried out, and an opportunity given, early in the meeting, for the formation and renewal of acquaintances. The excursions so generously provided were of great interest; but we venture the assertion that the mass of the visitors gained but little accurate information. By providing for such an occasion an appropriate manual or guide, or possibly a larger reception committee, the advantage to the guests can easily be quadrupled. It might even be better, as was done at the last meeting, to devote the whole day to a well-planned visit to a single establishment.

The society met in joint session with the Engineers' society of western Pennsylvania, whose president, Mr. Miller, welcomed the visitors, and invited their president, Prof. John E. Sweet (formerly of Cornell university), to the chair. The evening of May 20 was devoted to the report of Messrs. Roberts, Phillips, Hunt, McDowell, and Jarboe, — a committee appointed, at the January meeting of the local society, to investigate the whole subject of natural gas. There are also a city, and an underwriters' committee on the same subject.

Though Pittsburgh is within reach of three or four prolific localities, and gas has been used for many years, it is but recently that any organized effort has been made to use it on a large scale. Already there are a hundred and fifty companies chartered in the state, representing over two million dollars; and gas is brought from eight to twenty-five miles for use in the city. Five-inch mains are being followed by eight-inch, new wells are being bored, and the time when Pittsburgh shall become a smokeless city may not be far distant. Though the gas is used under a pressure of a few ounces, the pressures at the wells run from fifty to a hundred and twenty-five pounds: this is due to the friction in the mains, five pounds being allowed for each mile. If the flow be shut off the pressure runs up much higher, and great difficulty has been experienced in making tight joints; cast-iron is too porous, and ordinary pipe-threads do not fit well enough. A number of new coupling-devices were exhibited, in some of which a lead packing was used. No allowance for expansion need be made, as the gas maintains an even temperature of about 45° F. When gas is allowed to burn freely at the mouth of a well, the cold produced by the expansion is such that ice has been projected through the flames.

The gas is used in all kinds of furnaces for making steam, iron, glass, etc.; and electric-light carbons, and the finest lampblack for printing-inks, are made from it: but it is used with suicidal wastefulness, which causes anxiety, as many wells give out in less than five years. The report looks to its economic and safe control. For household use it might otherwise be dangerous; and such use has commenced, though no practicable method of deodorizing it has been found. Being composed largely (ninety-six per cent) of marsh-gas, its value as a heating-agent is high, and its density is about half that of air. One pound (23.5 cubic feet) of gas has a theoretical evaporating-power of twenty-four pounds of water, twenty pounds having been actually evaporated. The best method of burning it is not generally known: experiments with injector-burners show that they do not suck in sufficient air for complete combustion, and the best results have been from numerous jets in contact with the whole heating-surface of the boiler. The value of the gas, as compared by evaporation tests with coal at $1.40

per ton, is only eight cents per thousand feet (which suggests that even our ordinary gas companies make profits), but its use is immensely more convenient; no stacks are needed, and the furnace reduces to a simple non-conducting chamber. The gas has just been turned on to the city water-works; and on the afternoon of May 22 a well was reported on the property of Mr. Westinghouse, near Pittsburgh. On the first day's excursion numerous furnaces were seen running with gas blown in through rough, one-eighth inch nozzles; and two or three lines of five-inch pipe lay on the surface of the railway embankment.

Mr. J. W. Cloud, engineer of tests for the Pennsylvania railroad, read a paper on helical springs. It was here claimed that round steel is better than square, flat, or other shaped; and an investigation, mathematical and experimental, was described, on the usual and mainly correct hypothesis that the strains are entirely torsional. Bars of oil-tempered and untempered steel, five feet long by three-fourths to one and five-sixteenths inches diameter, had been tested, and the constants of elasticity, etc., obtained; after which the springs had been coiled and again tested, and the results compared with theory. The proper arrangement of springs, when several are used together, was discussed, and certain proportions shown to be necessary for springs arranged concentrically. Detail drawings of springs for classes V and X were shown. Experiment has proved the principles to be correct on which these have been designed. Altogether, the paper is valuable as the commencement of an investigation, which, pushed to completion, will render the designing of all kinds of helical springs an exact science. In the discussion it appeared that springs of peculiar shape found their way into the scrap pile; that the introduction of peculiar designs under freight-cars often resulted in an enormous percentage of breakage; that orders to manufacturers are often arbitrary, and contrary to sound principles; that logs are loaded on cars by dropping them from a height of ten feet; and that springs are tested by pounding them together with a steam-hammer, after which they are expected to stand ordinary wear.

The greatest scientific interest, however, attached to the paper of Prof. W. A. Rogers of Cambridge, on a practical solution of the perfect-screw problem. Professor Rogers prefaced the reading by remarking that he considered the American society of mechanical engineers the most appropriate body to receive his first public announcement of success, — a courtesy appreciated by the society. Mechanism of precision was defined as perfect "when it meets all the requirements of the purpose for which it is constructed;" and the two screws, which raise the cross-head of an iron-planer, were discussed in this respect. Precision-screws are tested, not only by direct measurement of the pitch, but by examining optically a surface ruled with many thousand lines to the inch by means of the screw. The first catches all accumulated errors, while the 'diffraction grating' tests the regularity of the spacing for short distances. Scales graduated in Europe, and advertised as without sensible error, are shown, under the comparator, to merit no such claim: indeed, if we except Professor Rowland's, no screw has hitherto been made, capable of producing graduations sufficiently exact. Three half-metre screws were exhibited which could be mounted for microscopical examination: on one of them, over twelve hundred hours had been spent to make it, by usual methods, as perfect as possible; another, made by the new process, had required but twenty-two hours, and yet, while the microscope showed great irregularities in the former, none could be detected in this; the third was a similar screw before its final grinding. Professor Rogers produces a perfect screw by the following process: an ordinary, well-constructed lathe is used; and cuts of various depths are taken on a preliminary screw, for the purpose of tabulating the errors of the leading screw of the lathe as compared with a standard measuring-bar. This being done, a micrometer-screw is used to vary the relation between the leading screw and the cutting-tool. This screw is kept moving automatically, or by hand, so as always to correspond with the tabulated values, which results in producing a screw nearly free from the errors of the leading screw. This screw is then ground with a nut cut in the same way; and, if not sufficiently perfect, it is then put in the place of the leading screw, and another screw cut from it by the same method, whereby any remaining errors are eliminated. A company has been formed for putting perfect screws on the market.

In the animated discussion which followed, President Sweet gave his experience in constructing the Cornell measuring-machine, and claimed that the nut should be made as long as the screw to avoid unequal wear of the latter. Among other opinions, it was claimed that scraping surfaces to a bearing is better than grinding; that tempered steel should be used, and other means devised for maintaining the screws perfect; and J. A. Brashear was referred to as having solved the problem of flat surfaces up to five inches diameter.

Mr. W. E. Kent of New York presented rules for conducting boiler-tests, in which the precautions necessary for determining the actual heating-power of a fuel, or the efficiency of a steam-boiler, were set forth at length. A committee was appointed to report upon a uniform method of making such tests. Mr. W. B. LeVan resumed his advocacy of quick transit in a paper, 'New York to Chicago in seventeen hours,' in which the time required for each of eight divisions was figured out, the average hourly mileage being fifty-five, whereas seventy to eighty miles is a common speed for short distances between Philadelphia and New York. A change in locomotive valve-motions was also recommended. Mr. Charles E. Emery read 'Estimates for steam-users,' in which he detailed the methods and formulae in use by his company for arriving at the amount of steam furnished to various classes of customers. The New-York steam company has been selling steam at a fixed price since February, 1883.

Mr. H. R. Towne, of the Yale & Towne company, explained their drawing-office system, by which all

the operations of planning, making, lettering, dimensioning, altering, blue-printing, indexing, and preserving drawings, are reduced to a systematic procedure.

The remaining papers, for which, however, but little time remained, were: 'Cross-sectioning with the right-line pen,' J. B. Webb; 'Comparison of three modern types of indicators,' G. H. Barrus; 'A positive speed-indicator,' O. Smith; 'The experimental steel-works at Wyandotte,' W. F. Durfee; 'Early history of the steel-works at Troy,' R. W. Hunt; 'Experiments on non-conducting coverings for steam-pipes,' J. M. Ordway and C. J. H. Woodbury.

Professor Webb's paper referred to methods in use in his drawing-classes, with specimen of work.

Mr. Barrus gave the weights of the parts of the indicators, but neglected their moments of inertia: he compared the general appearance of the diagrams, and the correctness of the parallel motions: the errors of the springs were given, and the action of the drum mechanism discussed by means of an apparatus for detecting changes of phase. Some of these experiments seem to be in the right direction, but no discussion of underlying mechanical principles was attempted. Mr. Smith's machine is a counter for revolving shafts, *with a clock* which throws it in gear for one minute. The other papers will be read and discussed at the annual November meeting in New-York City.

Thursday was devoted to an excursion, by rail, up the Alleghany River for the purpose of visiting various works and furnaces. Among these were the Spang steel and iron company's works, the Isabella furnaces, the National soda-works, and the Plate-glass works, using natural gas as a fuel. A subscription dinner on Thursday evening, and a water excursion up the Monongahela on Friday, completed the programme of this meeting of the society.

DEVELOPMENT OF THE THYROID AND THYMUS GLANDS AND THE TONGUE.

UNDER the wide title of 'Ueber die derivate der embryonalen schlundbogen und schlundspalten bei säugethieren' (*Arch. mikr. anat.*, xxii. 271), G. Born discusses the development of these organs as determined by observations on pig embryos. These valuable researches give us, for the first time, an understanding of the morphology of the two glands of the above title, which have been a long-standing puzzle to comparative anatomists.

The tongue arises from the anterior part of the ventral floor of the pharynx. The space between the ventral ends of the first and second visceral arches is at first depressed; but later a longitudinal ridge grows up, separated on each side, by a groove, from the arches. The anterior portion of this ridge grows out, and becomes the free part of the tongue: the posterior part of the ridge projects between the third and fourth arches, and develops into the epiglottis. It will thus be evident that the tongue does not extend back beyond the second arch. After the embryo (pig) reaches a length of fifteen millimetres, the tongue grows rapidly forward. (Although it has long been known that the tongue arises from the floor of the pharynx, the evident conclusion has not been sufficiently recognized, that the epithelial covering of the tongue is entodermal, and not ectodermal, and therefore not the same as the lining of the mouth, as a continuation of which the lingual epithelium is customarily described.)

The fate of the visceral clefts has been more fully elucidated than heretofore. The *first* becomes the outer and middle ear and the Eustachian tube, as is well known: the fate of the others has been obscure. According to Born, the *second* entirely disappears, becoming first a closed sac, and finally undergoing complete atrophy; the *third* likewise becomes a closed sac, which remains some time connected with the epidermis; from the inner end of the cleft arises a short caecum, extending ventrally inwards and forwards, which is the *anlage* of the thymus, and is retained and enlarged, while the rest of the cleft is atrophied; the *fourth* cleft also remains in part as a closed sac, which later joins in the formation of the thyroid gland.

The thymus was first shown by Kölliker (*Entwickelungsgeschichte*, 2te aufl.) to be an epithelial organ, and probably derived from a gill-cleft. Born traces its origin from the third cleft, as a ventral evagination near the inner opening. The caecum grows, at first, without altering its position or general appearance; but the rest of the cleft is reduced to a small canal, the outer part, indeed, to a solid cord of cells (embryo pigs of about sixteen millimetres). The whole, except the thymus portion, is atrophied, but the outer cords persist for a time. The thymus *anlage* spreads out into a canal, with walls of fine, many-layered epithelium. The lower end of the canal rests against the pericardium, where the aorta makes its exit. In embryos of two centimetres, the lumen of the canal has disappeared, and from the solid cord many branches have grown out, most abundantly at the heart end.

The thyroid gland, as was first shown by W. Müller (*Jenaische zeitschr.*, vi. 428, 1871), has a double origin. Born shows that the principal division arises as a median invagination in the floor of the pharynx, on a line with the front edge of the second visceral cleft. Very early this invagination separates from the pharyngeal epithelium, expands laterally chiefly, changes to a network, and at the same time moves backward until it comes to lie behind the glottis. Until the embryo is two centimetres long, the thyroid mass lies near the origin of the third aortic arch (common carotid); but in older embryos the division of the carotids has moved back, away from the head and the thyroid gland. The secondary portion of the thyroid is derived from the paired remnants of the fourth clefts. The median portion of the thyroid early changes into a network of epithelial cords. The outer cells of the cords are cylindrical: the inner cells, in several layers, are not very distinct from one another. Around the cords, the mesoderm forms sheaths of spindle cells, while between them the blood-vessels appear. The lateral *anlagen* become

somewhat pear-shaped, the large end lying ventrally. The lumen is retained until the fusion with the median part is accomplished by the union of the large end of the side components with the central division: the large end soon after assumes the characteristic net-like form of the thyroid gland; but the lateral portions can still be distinguished for some time by the lesser size of the meshes, and the greater size of the cords of the network into which they change.

In the introduction to his article, Born refers to the previous writings of Stieda and Wölfler, and closes with a criticism of the same, and other publications based upon his own researches. The most important point to be noticed is the correction of Wölfler's mistake in describing the second cleft as the first. (In this abstract, the author's arrangement of the matter has not been followed, as it appeared little conducive to clearness). C. S. Minot.

RESEARCHES ON ASTRONOMICAL SPECTRUM-PHOTOGRAPHY.

At the time of his death, in November, 1882, Dr. Henry Draper had, for a number of years, been largely occupied with very tedious and costly investigations connected with the photography of the spectra of the heavenly bodies, his unusual adaptedness for the prosecution of which research conducted him to results of the highest importance. With true scientific spirit, Mrs. Draper has generously placed at the disposal of Professor Young and Professor Pickering all the data necessary for the proper publication of the work; and, in a monograph of about forty pages, the former gives an introduction to Dr. Draper's researches, together with a description of the apparatus with which they were made, extracts from the original note-books, and a list of the photographic plates in Mrs. Draper's possession; while the latter, who took a number of these plates to the observatory of Harvard college in the spring of 1883, presents the results of his measurements, accompanied by a discussion of the plates.

Dr. Draper's attention appears to have been first turned toward spectrum-photography in 1869 and 1870, although his photographic work in other fields previously to this time had been singularly successful. His first work in science, conducted while a medical student in New York, and which related to the function of the spleen, was illustrated with microphotographs of great excellence; and very soon after taking his degree, while on a visit at Parsonstown, Ireland, he became so thoroughly impressed with the photographic possibilities of the great reflecting-telescope of the Earl of Rosse, that, soon after his return home, he began the construction of a metallic speculum of fifteen inches diameter, which was soon replaced by a number of silver-on-glass mirrors of about the same size, the details of the construction and mounting of which formed the subject of one of the Smithsonian contributions to knowledge, published in 1864. Seven years later, he had completed with his own hands the entire construction and mounting of a twenty-eight inch silvered-glass mirror, with which he obtained, in May, 1872, his first photographs of the spectrum of *a* Lyrae by merely inserting a quartz prism in the path of the rays, just inside the focus of the small mirror, and employing neither slit nor lenses. Three months afterward, the same method secured for him plates showing four lines in the spectrum of the same star. For two or three years following, Dr. Draper's time was, for the most part, occupied with other lines of work, connected with investigations of the solar spectrum, and the superintendence of the photographic preparations for the transit of Venus of 1874. He returned to the subject of stellar spectra in 1876, obtaining a number of photographs with a fine twelve-inch refractor by Alvan Clark & Sons. This instrument, now the lesser telescope of the Lick observatory, was replaced in Dr. Draper's establishment, in 1880, by an eleven-inch Clark refractor, which was provided with a correcting-lens fitted to be placed in front of the object-glass to adapt it to photographic work. This instrument was mounted on the same set of axes with the twenty-eight inch Cassegrain mirror, as were also a finder of five inches aperture, and one of two inches, — all of which are well shown in the picture of the telescopes in the Hastings observatory, vol. i. of *Science*, p. 31.

Dr. Draper's eminent successes in celestial photography were due in large degree to his own skill and discoveries in the manipulation of the sensitized plates. Until 1879, wet collodion plates were used in all his experiments; but after that time he employed exclusively the dry plates made by Wratten & Wainwright, to the admirable performance of which, in the hands of Dr. Huggins, his attention was called by that distinguished astronomical physicist, on a visit of Dr. Draper to England in 1879.

Professor Young directs attention to the fact that the investigations of stellar spectra were by no means carried on continuously, but only during Dr. Draper's summer residence at his country-place, and in the intervals of other, to him, even more absorbingly interesting researches and urgent business occupations. The difficulties proved to be well-nigh insurmountable; for at first the limitations imposed upon the time of exposure by the use of the wet process made it almost impossible to get impressions of sufficient strength, — a difficulty which vanished on the introduction of the modern dry-plate processes: and another difficulty, increasing with the length of the exposure, was that of securing a sufficiently accurate movement of the driving-clock. No less than seven such clocks were constructed before he succeeded in getting a perfect one. Its regulator was a pair of heavy conical pendulums, so hung that their revolutions were sensibly isochronous through quite a range of inclination. The gearing and driving-screw were constructed, for the most part, by Dr. Draper himself, with the utmost care and accuracy; and Professor Young says, that, in its ultimate perfected condition, the driving-clock was as good as any in existence, being able to keep a star upon the slit for an hour at a time, when near the meridian, and not disturbed by changes of refraction.

And besides, the effect of changes of temperature upon the spectroscopic portion of his apparatus, and the difficulty of securing nights on which the atmosphere would not cut off the actinic rays to an unusual degree, not to mention the fact that the observatory was more than two miles distant from his residence, — these and many other conditions hindered the progress of the work. Spectrographic operations are, as Professor Young well says, much more sensitive to atmospheric conditions than are visual observations.

As regards the spectroscopic apparatus, a great many forms were employed, the first of which has already been mentioned. Later, direct-vision prisms were used in the same way, and spectroscopes made up of such prisms, some with a slit, some without, and some with a cylindrical lens to give necessary width to the spectrum. In the definitive arrangement of the apparatus, with which all the plates measured by Professor Pickering were made, a remodelled form of Browning's star-spectroscope formed the basis of the instrument; the telescope and collimator each having a focal length of six inches, and an aperture of 0.75 of an inch. The eye-piece and micrometer being removed, a block of hard wood was fitted on in such a way as to carry the photographic plate (a small piece of glass about an inch square); and a small positive eye-piece was mounted on the block, so that the yellow and red portions of the spectrum, projected beyond the sensitive plate into the field of view, could be examined at pleasure. It was thus possible to be sure that the driving-clock was running properly, and that all the adjustments remained correct. The whole apparatus weighed less than five pounds, and could be screwed on the eye-end of whichever telescope it was desirable to use it with. The development of the plates was usually by ferrous oxalate, though the alkaline development and pyrogallic acid were both used on some occasions. The pictures were about half an inch long, and one-sixteenth of an inch in width, extending from a point between the Fraunhofer lines *F* and *G* to a point near *M*.

Professor Pickering divides his work on these plates into three parts: first, the determination of the relative positions of the lines in the various spectra in terms of any convenient unit of length; second, from the known spectra of the moon and Jupiter, a determination of the relation of these measures to wave-lengths; third, a reduction of the measures of the stellar spectra to wave-lengths, and a discussion of the results. The stars whose spectra have been measured are α Aquilae, α Lyrae, α Aurigae, α Boötis, and α Scorpii. The spectrum of the first of these stars is remarkable for containing, in addition to the intense broad hydrogen-bands which characterize the spectrum of α Lyrae and similar stars, a multitude of very fine lines, which are easily seen between *G* and *H* in several of the plates, but are too delicate to be satisfactorily measured. Dr. Draper considered these fine lines very important as showing that Altair should be regarded as a sort of intermediate link between α Lyrae and Sirius on the one side, and Capella and the sun on the other.

On the plates of the spectra of α Aurigae and α Boötis, not only do the lines appear to coincide in position with those of the sun, but their relative intensity seems to be nearly the same. Of the twelve lines seen in at least seven of the nine spectra of the moon and Jupiter, every one is contained in the spectra of both α Aurigae and α Boötis. Of the fifteen lines which are so faint as to be contained in but one or two of the spectra of the moon or Jupiter, only four are contained in the spectrum of α Boötis, and but one in that of α Aurigae. There is therefore no room for doubt of the correctness of Professor Pickering's conclusion that the evidence afforded by these photographs is very strong indication of the sameness of their constitution with that of our sun.

Professor Pickering's method of deriving his results from these plates is worthy of note here, as indicating the great degree of confidence to which they are entitled. To secure entire independence in the results, the measures were completed before the reductions were begun. The lines in each plate were measured without comparison with any map, and no search was made for lines which appeared to be wanting. When two similar spectra were photographed side by side, care was taken to cover one when measuring the other. Under these circumstances, the agreement in the measures of several plates is strong evidence of the identity of the spectra.

Appended to this monograph are three of the papers of Dr. Draper, reprinted from the *American journal of science:* 1°, On photographing the spectra of the stars and planets (December, 1879); 2°, On photographs of the spectrum of the nebula in Orion (May, 1882); and, 3°, Note on photographs of the spectrum of comet *b* 1881 (August, 1881). The first of these papers gives, in brief form, a very lucid statement of the conditions of the problem of celestial spectrum-photography, as well as the obstacles which he had, up to that time, overcome in solving it.

DAVID P. TODD.

THE GEOLOGY OF THE ASTURIAS AND GALICIA.

Recherches sur les terrains anciens des Asturies et de la Galice. Par CHARLES BARROIS, docteur ès-sciences. Lille, *Six-Heremans*, 1882. 630 p., 20 pl. 4°.

IT was the good fortune of one of the writers of this review to see this work in process of evolution in the workshop and study of its hospitable author in Lille; but much as he admired the indomitable energy and patience which were presiding at its birth, as well as the copious notes and experience which were being assimilated into this monograph, the result is a surprise. How much more must it surprise those who are unacquainted with Dr. Barrois, to learn that he is but little past his thirtieth year; that this is but one of several important memoirs which he has begun and

completed alone; and that he has been able to do this while his chair in the faculty of science at Lille (Academy of Douai) was demanding the constant and fatiguing work of lectures and preparation, and his arduous labors in Brittany under the geological survey of France suffered no interruption!

Without the experience which he gained, both in the field and in the art of publishing, by his important and now often quoted "Recherches sur le terrain cretacé supérieur de l'Angleterre et de l'Irlande," which won him his doctorate from the University of France, he would hardly have been so successful in this last book. Both works begin with historical notices and bibliographies; but in the latest the first four pages are devoted to a veritable history of the labors of his predecessors, rather than to a mere list of their books. At the end of this, however, there are nearly four pages of titles rained upon the reader, as if Dr. Barrois were anxious to terminate this part, and get at his subject.

Accompanying this large and handsome quarto is an atlas in the same form, which contains twenty plates reproduced in the best style of art at the present day. The first three of these are colored plates, representing ten thin sections of rocks under the microscope and in polarized light. Each plate is conveniently covered by a thin tissue sheet containing the outlines of the constituent minerals, with the letters and figures necessary for indentifying them. Following these are fourteen plates of fossils, of which four are from the hand of the author; nine were drawn by the lithographer, Mr. C. Rogghé; and one is a phototype from the *Ateliers de reproductions artistiques* in Paris. The last three plates are in order: one of vertical sections, one of section sketches, and one of pure sketches, on which latter interesting and important geological phenomena have been marked. Viewed as a whole, the artistic work is as perfect as any set of illustrations of scientific matter which the writer reremembers to have seen. Where fault is so hard to find, he may be pardoned here for mentioning the only additions which it seems to him could have made the plates clearer; viz., a note of the amount of enlargement of the figures of plates ii. and iii., on the pages opposite those plates. Plate i. is thus provided.

The first part of the subject of this review (161 p.) is devoted to lithology. It is interesting and valuable, and will do much to increase the reputation of the author. It treats of the general and microscopic characters of the sedimentary rocks, including schists, phyllites, quartzites, limestones, and mimophyres; and the crystalline massive rocks, comprising granite, quartz porphyry, diorite, diabase, and recent quartz-bearing kersantite. The schists are of every age, from the Cambrian to the carboniferous; and he divides their mineral ingredients into two classes, — those which were clastic, and prior in origin to the consolidation of the rocks; and those which were secondary, or crystallized out during the consolidation. The first class includes quartz, felspar, and white mica; the second, quartz, rutile, tourmaline, white mica, and chlorite. The term 'mimophyre' is given by Barrois to a series of felspathic, porphyritic, and schistose rocks, which he thinks were formed from volcanic ashes and detritus, — the same as most porodític felsites are known to have been formed. The mimophyres are found associated with the sedimentary schists, quartzites, and phyllites, and belong to the Cambrian, Silurian, and Permian.

Of the plates, it is sufficient to state that they were made by Jacquemin, who prepared those for Messrs. Fouqué and Lévy's 'Minéralogie micrographie.'

The second part treats of the paleontology of the Cambrian and Silurian (chap. i.), and of the Devonian and carboniferous (chap. ii.), and occupies 217 pages of very interesting matter; to which, however, it will be impossible here to make more than the briefest allusion. We learn from a prefatory note, that Dr. Barrois has succeeded in collecting three hundred and eighty-five species of fossils from the field of his labors in this part of Spain. Of these, thirty-nine are new species, which we owe to his research; viz., three in the Cambrian and Silurian, twenty in the Devonian, and sixteen in the carboniferous. The syllable 'Barr.,' affixed to many others, is apt to lead the hasty reader to ascribe these also to him; but the abbreviation is for Barrande, and not Barrois. The author's note (p. 177) on the right of precedence of Professor Haldeman's Scolithus over Ronault's Tigillites is a model of impartial justice and scholarly treatment of the subject.

Following the detailed description is a *résumé* (pp. 359 to 385) containing considerations by Dr. Barrois on the genera and species just referred to, with special regard to their parallelisms; and the chapter is concluded by speculations on the conditions under which the deposits have been formed. In the following chapter (ii.) the same method is applied to the fossils of the Devonian and carboniferous.

The third part is devoted to the stratigraphy, including, of course, the description of cross-sections. It is no fault of the author that this

portion of the work is more difficult to follow, owing to the necessity of subdividing the cross-sections, like the previous parts of the book, in accordance with the limits of the great formations. This difficulty is inherent in the case, and lies in deciding how to put the diverse phenomena before the mind in 'natural order' (much-abused phrase). If we follow the geographical divisions, there must be a continual interruption and resumption of the same geological horizon; whereas, if the geological boundaries are alone regarded, the geographical continuity is broken. Of the two solutions, perhaps the second is the better. The first of these subdivisions (chap. i.) is the 'primitive terrane' (used by de Castro to imply nearly what is meant by the archaean of Dana). It is very interesting in this connection (and not unexpected), to find that the upper division of the 'primitive' consists of the *roches vertes* which occupy this position in South Wales, the Appalachian belt, and in so many other places. They are mingled with chlorite schists and talc schists overlying the mica schists of Villalba, which latter contain biotite, muscovite, orthose, plagioclase, and two kinds of quartz; with garnet, zircon, sphene, and oligiste as accessories. Gneiss has been observed by Dr. Barrois only in subordinate thin layers intercalated among the mica schists.

The same is true of the garnetiferous amphibolites; but the difference between this Spanish stratigraphy, and that of those regions where similar rocks have been observed in America and in Europe, is, that the series in the former case are concordant. The Laurentian would appear, from Dr. Barrois' conclusions, to be wanting in the outcrops of Galicia, and the above-mentioned measures to represent a great development of the Huronian. The succession of Cambrian beds, both in the Asturias and in Galicia, he finds perfectly in accordance with Barrande's views of this part of Europe. From a fossil of Archaeocyathus (Billings), characteristic of the Potsdam sandstone, found in the limestones of El Pedroso, MacPherson forms a column in which he thinks that possibly the Laurentian is represented at the base by mica and talc schists, with intercalated limestones of various colors, and sometimes filled with actinote (actinolite), and, more rarely, intercalated beds of felspathic grauwacke. On this rest argillaceous, splendent, siliceous talc schists, sometimes containing chiastolite; and on these, three benches of conglomerates, tuffs, and argillaceous schists and limestones, which he refers to the Potsdam sandstones.

Following this are details of the sections in the Devonian and carboniferous. The sixth chapter treats of the phenomena which have modified the position of the paleozoic strata since these latter have been deposited. His conclusion is, that the Cantabrian Mountains owe their origin to two distinct lines of pressure; the one acting along east and west, and the other along north and south, lines. The former occurred between the carboniferous and Permian ages; and the latter, between the eocene and miocene.

The last subjects treated are the effects of denudation and the details of the actual surface-relief.

The work has been built on strong and sure foundations, and will long be cited as an authority. It is full of new facts and suggested analogies, and is characterized by thoughtfulness, industry, and modesty.

LOCKWOOD'S ELECTRICITY.

Electricity, magnetism, and electric telegraphy: a practical guide and handbook of general information for electrical students, operators, and inspectors. By THOMAS D. LOCKWOOD. New York, *Van Nostrand*, 1883. 377 p., illustr. 8°.

As indicated in its preface, Mr. Lockwood's unpretending book is not primarily intended for those having any considerable previous knowledge of the subject of electricity, but for the large number of persons who have not had the advantage of a scientific education, and yet find themselves in the employment of telegraph, telephone, or electric-light companies in various subordinate positions. To this class of persons the information contained in the work will doubtless be of great value; and, indeed, we do not recall any one book, of moderate size and price, in which so many of the different applications of electricity are considered in an elementary manner. To one familiar with the subject, the treatment of the more important topics must, of course, seem brief and occasionally superficial; but, recollecting the design of the work, it can hardly fail to win commendation, even from those who most clearly recognize its deficiencies.

The chapters on line-construction, office arrangements, and the adjustment and care of instruments, are excellent: and a very clear description of the principles of duplex and quadruplex telegraphy is given. There is also a good account of Mr. Gray's interesting harmonic multiple telegraph. Mr. Delany's ingenious multiplex synchronous telegraph is not described, probably because it did not

become well known until too late for insertion; but we hope it may find a place in a future edition. The telephone has a chapter devoted to it. We wish that the theory of the instrument had been stated more at length, and are surprised to find not even a reference to the musical telephone of Reis.

The preceding remarks apply especially to the latter and technical portion of the book. The earlier chapters, which treat of various theoretical matters, are less worthy of praise. The definitions of electrical units are in some cases far from clear. Some of the remarks on p. 96, regarding the unit of capacity, are quite misleading. There are also some apparent slips of the pen. Such, for example, is the statement on p. 119, that the resistance of a battery increases in direct proportion to the number of cells, which is evidently true only when the cells are connected entirely in series. To the same origin we may probably trace the erroneous statement on p. 94, regarding the use of the terms 'weber' and 'weber per second.' The chapter on electrical measurements seems rather to be compiled from text-books than derived from the writer's knowledge of such experimentation, and hence fails to have the suggestiveness that is found in some portions of the book. The few pages devoted to electro-therapeutics are unworthy of the title, and do not deserve insertion in a separate chapter; and more discrimination might well have been employed in the descriptions of the various electric lamps. The question-and-answer style is a disadvantage, which would be removed by the substitution of proper marginal titles.

A NEW CLASSIFICATION OF THE MOLLUSCA.

Encyclopaedia Britannica. 9th ed., vol. xvi., pp. 632-697. *Article, Mollusca.* By E. RAY LANKESTER.

As a rule, it is hardly in the ponderous tomes of an encyclopaedia that one looks for new, fresh, and breezy contributions to biology, or for epoch-making articles on biological topics. One rather expects the carefully weighed and sifted results of investigation which has already borne the test of publication and discussion, prepared for general comprehension by a divestment of all unnecessarily technical terms. In the present instance, whatever be the feelings of the layman who may refer to it, the scientific student of the Mollusca will be agreeably disappointed. It is rumored that the distinguished author has in preparation a manual of the invertebrates, of which it may be assumed this article is the forerunner. For this reason, even in our limited space, which forbids a really thorough discussion of so large a topic, it is desirable that the attention of specialists should be called to it.

The school of which Professor Lankester is one of the leaders is marked by certain well-recognized features. They have broken away from the fetters of all previous zoölogical classification. Armed with the latest instruments and methods, they attack biological problems with ardor, and rarely fail to add materially to our knowledge, whatever be the subject treated. A new biology has arisen, and the gospel thereof is pedigree. By their ancestral trees shall ye know them, under whatever adult garb they may conceal themselves, — this is the new law of the new prophets.

So great a truth is contained in it, so rich the harvest under its stimulation, and so unanimously has it governed the generation first brought under its beneficial influence, that even yet to doubt its infallibility and ubiquity of application is to stigmatize one's self as a biological Philistine. Nevertheless, it is becoming pretty generally admitted that the relations of pedigree fail, in many cases, to express adequately the relations of adult animals as we find them in nature; and that the genealogical stand-point, like any other single stand-point, taken by itself, is inadequate to the broadest and truest view.

Professor Lankester's work has the merits of his school in a very decided degree, while some of its faults are equally well marked. These we shall endeavor to point out, though limitation of space will compel us to do much less than justice to both.

"The Mollusca," he tells us, "form one of the great phyla or sub-kingdoms of the animal pedigree or kingdom." After a very slight sketch of the history of molluscan classification, the works of Woodward and Bronn are mentioned with deserved approval, the latter being termed "the most exhaustive survey of existing knowledge of a large division of the animal kingdom which has ever been produced;" which would be true, if, for 'existing knowledge,' we were to read, 'knowledge existing twenty years ago.' Notwithstanding its great merits, the work of Bronn is now antiquated in many respects, as well as out of print, yet, so far, has found no worthy successor. If to the admirable and careful exposition of previous systematic work, characteristic of Bronn's monograph, Professor Lankester will join the biological results of the last twenty years, bringing both up to date, he will merit even higher

praise than that he has bestowed upon the German naturalist.

The plan of the work we are reviewing is excellent. In place of attempting a hard and fast definition of the molluscan phylum, he has described and figured an architypal mollusk in detail; and the reader, once familiarized with this type, can follow clearly the discussion of the subordinate branches. These are taken up seriatim, beginning with the more archaic forms. The phylum is divided by Lankester into two great branches,— the Glossophora and the Lipocephala. The first comprises three classes, — Gastropoda (in its widest sense); Scaphopoda, or the Dentalia; and Cephalopoda, with which the author includes not only the cuttles, etc., but the Pteropoda. The Lipocephala are equivalent to the Acephala of Cuvier, or the Lamellibranchiata of authors.

So far, the position of the Pteropoda (though not absolutely new) with the Cephalopoda, rather than as a class by themselves or as a subclass of Gastropoda, is the chief difference from the generally accepted classifications, and one which will be much criticised, if not finally rejected; since the little that is known of the embryology of the pteropods differs in important features from that of the cephalopods.

The Gastropoda are first discussed in a general way, and, on the whole, in a most satisfactory manner. We could wish, that, in introducing new Greek derivatives, some attention had been paid to euphony; for surely that melodious language can afford better terms than *gonad* ('sexual organ'), *osphradium* ('sensory organ'), *ctenidium* ('gill'), and others which grate upon the ear. We note among details the erroneous statement that the radula is horny (it is really chitinous), and that the jaws are usually calcified, and almost universally present. No single instance of a calcified jaw among recent Mollusca occurs to us, and there are large groups without a jaw. The jaw is composed of a substance allied to chitine, more or less combined with really horny material, the former defying alike the strongest acids and alkalies to reduce it.

The recognition of the radula as a feature of the highest systematic importance is very welcome: it is only to be regretted that the author seems to have fallen into utter confusion in his endeavors to indicate formulae for the teeth, and to have followed, without much investigation, the crude notions of Dr. Macdonald, rather than the researches of Troschel, Lovèn, Woodward, or Sars. It seems also to have escaped him, that the radula is occasionally (though rarely) absent.

The author divides the Gastropoda into two subclasses, Isopleura and Anisopleura, characterized by the relations of the organs, which, in the former and more archaic group, are bilaterally symmetrical with a posterior anus: in the Anisopleura the visceral mass has been subjected to torsion, bringing the anus to the anterior right side, while the concomitant twisting of the remainder of the intestinal mass results in a masking of the original symmetry. In the process when originally brought about, if the termination of the intestine was sufficiently low, it became entangled in the pedal nervous loop, which, in following it, acquired a figure-of-eight form. If, on the other hand, the plane of intestinal torsion was above the pedal loop, the latter did not participate in the torsion, and in the succeeding generations retained its simple character. These relative features, observed by Spengel in a number of mollusks, are made, after him, the occasion of two super-ordinal groups, — Streptoneura and Euthyneura.

We regard the establishment of the subclasses above mentioned as a decided advance on previous systems, while it is doubtful if the super-orders will stand the test of future investigation. The character adopted as a basis is purely mechanical, and, so far as yet shown, without serious significance.

The isopleurous gastropods comprise the Chitons, Neomeniidae, and Chaetoderma, which are considered respectively as typifying orders. In our opinion, they should have been divided into two super-orders, — one the Polyplacophora, exhibiting a metameric repetition of the primitive shell-sac, and possessing a developed and functional foot; the other the Chaetodermida, without (as adults) a primitive shell-sac or shell of any kind, and with the foot aborted, or rudimental. The statement (p. 641) that the cuticular spines of the latter group 'replace' the shell, is not correct in a strictly scientific sense, and the expression were better not used; for these spines are absolutely identical with the spines of the girdle in Chiton, and have no relation to the true shell.

The Anisopleura Streptoneura are divided into two orders, Zygo- and Azygo-branchia, accordingly as the suppression of the originally left-side organs is or is not carried out. These characters we regard as unsatisfactory, and the division resulting as artificial; Haliotis, Fissurella, etc., being combined with the true limpets, while their (to our notion) much nearer relatives, the Trochidae, Pleurotomariidae, etc., are left in the other order. Recent observations on the limpets indicate that this arrangement cannot be maintained, though we

have not space for a full statement of the case.

It should be said, that only examples of groups in classification as high as families appear in the work. Of about two hundred and seventy-five families of mollusks recognized by malacologists of later date than Bronn, about seventy only are referred to; and the genera assigned to some of these are not at present considered to be properly so placed. This, however, is a mere incident, which greater research into the present state of the science, outside the ranks of professional embryologists, will make it easy to rectify.

The Streptoneura comprise a large part of the ordinary marine gastropods bearing shells, but to them are added the heteropods. On the other hand, the Euthyneura comprise the nudibranchs, pulmonates, and opisthobranchs, — a not unnatural assemblage, but which should hardly be kept out where Pyramidella, Entoconcha, and Phyllirhoë are let in. We do not find any indication of the place of Siphonaria or Gadinia.

The Solenoconcha stand alone. That the Pteropoda should do so, rather than have been consolidated with the Cephalopoda, many will be disposed to believe, as Lankester admits that the development of the embryo 'presents no points of contact' between them.

In the Lipocephala, unfortunately, we have nothing new; and the old and now defunct orders based on the number of adductor muscles are retained.

The remarkable characters of the group of Metarrhiptae are not alluded to; and Tridacna, the type, is actually included in one family with Dimya, Isocardia, Cyrena, and Cyprina. In fact, the families of Lipocephala adopted are, in the light of modern investigations, too archaic for serious criticism.

We have noticed, in passing, some errors, and some features wherein we differ from our author in judgment on the facts presented. But we should do him grave injustice if we did not, before closing this review, give our testimony to the great value of his work.

In this paper is brought together the best summary of the results of recent anatomical and embryological research on the Mollusca. It is fully (though rather rudely) illustrated with fresh and well-selected figures. Several of the diagrammatic series given are extremely clear, satisfactory, and instructive. The article is a mine of information as to anatomy and development, digested and put in rational sequence. It is, however, a sketch, in broad outlines, of the developmental history of the Mollusca, rather than a general treatise on the group. We hope that it, or an enlarged and improved treatise following on the same lines, may soon be accessible in better form for the student, whom it cannot fail to stimulate and instruct.

W. H. DALL.

ABORIGINAL LITERATURE OF AMERICA.

Aboriginal American authors and their productions, especially those in the native languages. By DANIEL G. BRINTON. Philadelphia, *Brinton*, 1883. 63 p. 8°.

The Güegüence: a comedy ballet in the Nahuatl-Spanish dialect of Nicaragua. Edited by D. G. BRINTON. Philadelphia, *Brinton*, 1883. 52+94 p. 8°.

THE first of these papers is an essay which grew out of a communication which Dr. Brinton made, in 1883, to the Copenhagen session of the *Congrès des Américanistes*. It is a bit of literary history, which groups, according to form of expression, — whether narrative, didactic, oratorical, poetic, or dramatic, — the various productions of the aborigines of America. It includes the writings in the native tongues of the Maya and Nahua races in the south. It embraces, also, the hot-bed literature of those tongues which have received their power of expression, in type, from the contact with the whites; as in the case, for instance, of the Cherokees. Nor are the efforts forgotten, of the training of those of Indian blood who have given expression both in the Latin, which was the common scholarly medium of the time of the Spanish conquest, and in the vernaculars which were acquired from the schools of the Spanish, French, and English settlers. This last phase extends the range pretty far beyond the scope of the linguistic interests attaching to the subject: but Dr. Brinton does not make it an essential part of his plan; and from his enumerations it clearly appears how much more receptive the nations which the Spaniards encountered were than the peoples of the north, brought to subjection by the French and English. The review which Dr. Brinton makes of the literary activity — if we may so call it — of all the American peoples, from the Eskimo southward, though but cursory, is a reasonably complete one, and opens a subject of great interest.

The second title is the third in a series of aboriginal American literature, which Dr. Brinton is giving opportunely to the students of the ethnological development of our indigenous races. In the present instance the

production is not purely Indian; for it is of comparatively recent origin, and represents the corruptions of both the Spanish and Aztec tongues, combined in a vulgar way. It is interesting, however, psychologically, and shows what humor and spirit can spring from the union of the races, which its jargon typifies. The text of the original is accompanied by a rendering into English; and in an introduction and notes, Dr. Brinton takes occasion, fortunately, to make record of a large amount of his curious and apposite learning.

M'ALPINE'S ZOÖLOGICAL ATLAS.

Zoölogical atlas (including comparative anatomy), with practical directions and explanatory text for the use of students. By D. M'ALPINE. 2 vols. New York, *The Century co.*, 1883. 16; 24 pl. f°.

THIS is a handsomely bound and finished work in two parts, dealing respectively with the invertebrates and vertebrates. It is intended as a guide to the student in the dissection of representative forms. The number of plates devoted to the different types is, however, hardly proportioned to their importance, much less to the commonness of their occurrence. Thus, four plates are assigned to Protozoa, and, of these, one and a half to the Monera. Perhaps so much space is given to these because the author knows that most students will never have the opportunity of studying the living forms. Yet this is hardly a sufficient excuse for crowding out altogether the Porifera and Coelenterata. Of these, not a single figure or diagram is given; although they are of universal occurrence, and far more important objects of study to the student than mere figures of Monera. The figures of Vermes are limited to those of the liver-fluke, tapeworm, and leech, all on one plate, while annelids are entirely neglected. At least one molluscoid, either a polyzoan or ascidian, might well have been added.

In his selection of vertebrates, the author has been far more fortunate; and he is to be especially commended for giving the anatomy of the salamander in place of that of the common, but unfortunately in many respects so abnormal, frog.

The drawings, unfortunately, leave the student in entire ignorance of the relative size of the different objects. Different organs and organic systems of the same animal are often drawn on a very different scale, and the student left to imagine that they are all alike, life-size, except that in marked cases the word 'enlarged' is added. The Protozoa are prodigious, but whether magnified five hundred or five thousand diameters we are not informed. All this might very easily have been obviated by the use of a few figures or a simple scale.

Some mistakes in drawing or anatomy occur in each part. Thus the stone-canal of the starfish (plate v., diagram 1) is represented as connected directly with the top of one of the Polian vesicles. If any one will compare the other figures on this plate, especially Nos. 3 and 4, with the corresponding figures in Professor Brooks's 'Manual,' he will see immediately how the finer points of anatomy, especially of the haemal system, have been neglected. Fig. 3 is particularly unfortunate.

So, too, in plate xiii., figs. 4 and 5, the nervous system differs in the two drawings; and in fig. 5 the single parieto-splanchnic ganglion seems to be represented nearly midway between the anterior and posterior adductor muscles, but without name, and its name given to two siphonal (?) ganglia represented on the posterior adductor. One or two similar instances occur in the part devoted to vertebrates. Both in figures and notes, the author supports the theory of the development of an ovary and 'seminal capsule,' and the production of ova, in Paramoecium. This is certainly a bold position, in the face of such observations as those of Professor Bütschli on the conjugation of several species of the same genus, and described and supported by Professor Claus. But with few exceptions, and these, perhaps, more the fault of engraver than author, the anatomy seems generally correct.

The plates of the part on vertebrates are very fair and distinct; but in the figures of many of the smaller invertebrates the masses of color are far more noticeable than the correctness or clearness of the details. The internal anatomy of the crabs in plate viii. is so indefinite as to be of little assistance to a student. The figures in plate ix. are much clearer. All through both volumes, finer drawing and engraving, and a more judicious use of color, would have made a vast improvement. The engraving, particularly, is not so good as the price of the work would warrant; by no means so clear as in many text-books on zoölogy and comparative anatomy. The notes are usually good, though sometimes rather more literary than scientific. The description of the individual or species does not always emphasize the most important characteristics of the class which it illustrates, of the order or family to which it belongs.

The book would be a great help to any one wishing to take up a practical course of dissec-

tion without a teacher; but, for most students in such a situation, it is too expensive, while most of the teachers in advanced schools and colleges will prefer the finer plates of some of the foreign comparative anatomies, or the drawings to be found in the books of reference of the larger libraries. To teachers of zoölogy who have not such libraries at their command, or who, on account of ignorance of the language, are unable to use German text-books, the atlas would undoubtedly be a very great assistance.

NEW METEOROLOGICAL JOURNALS.

Meteorologische zeitschrift. Herausgegeben von der Deutschen meteorologischen gesellschaft. Redigirt von Dr. W. KÖPPEN. Heft i., January. Berlin, *Asher*, 1884. 8°.

American meteorological journal. Edited by Prof. M. W. HARRINGTON. Vol. i., no. 1, May. Detroit, *Burr*, 1884. 8°.

METEOROLOGY has received an impulse, both in Germany and America, by the almost simultaneous issue of a monthly meteorological journal in each of these countries. The two journals are intended, however, to cover different grounds, and so it will be necessary to state the position of each separately.

The *Meteorologische zeitschrift* has for its editor one of the greatest of living meteorologists, and it is intended to be a sort of co-laborer with the Austrian journal of meteorology. Much will be expected of this publication, and the first number leads us to believe that these expectations will be realized. In fact, but for the slight difference in appearance, one might think he was reading a number of its Austrian rival. We find such names as Neumayer, Zenker, Krankenhagen, Sprung, Van Bebber, and Köppen, appearing as contributors to this first number. Its first twenty-eight pages contain original communications, then come nine pages of correspondence and notices, then four pages concerning the founding of the society, followed by four pages of members of the German meteorological society, three pages of bibliography and book-notices, and two pages of plates. Although this January number is issued in April, yet the editor hopes to send out the successive numbers in such rapid succession, that after September they will appear at the proper time.

The American meteorological journal is edited by a professional astronomer, who has recognized the needs of American meteorologists, and is self-denying enough to offer his services for their benefit. From no journal of this kind can one derive any pecuniary benefit; and it is the duty of meteorologists to help the editor, not only by communications, but also by subscriptions.

The matter of this first number of the journal is principally meteorological, and the topics treated are varied. The principal article is one on barometric waves of short period, and is by a well-known astronomer. In the early stages this journal will need the support of all astronomers and physicists who take an interest in meteorology, because we have not enough working meteorologists in this country to supply material enough to make the undertaking a success. Similar first steps taken in foreign countries have required this same aid.

Heretofore American contributions to our knowledge of meteorology have been scattered through various periodicals; but now they can be published together, and where they will be brought soonest to the notice of those interested. Although the editor will be forced to deal with the popular side of meteorology in order to make the journal readable to enough people to make the circulation large enough to pay the expenses, yet it is hoped that he will aim to make its scope as purely professional as possible. There are so many journals devoted to meteorology now, that one can only read the most important articles in each; and quality is of greater importance than quantity. The contents of this American journal are divided as follows: editorial notes; current notes; original communications; translations, etc., distributed over forty pages.

THE STUDY OF HEREDITY.

Life-history album, prepared by direction of the collegiate investigation committee of the British medical association. Edited by FRANCIS GALTON, F.R.S. London, *Macmillan*, 1884. 8+172 p., 8 pl. 4°.

Record of family faculties; consisting of tabular forms and directions for entering data, with an explanatory preface. By FRANCIS GALTON. London, *Macmillan*, 1884. 4+68 p. 4°.

WE have become accustomed to look for care and thoroughness in Mr. Galton's work, and it is pleasant to say that the two volumes before us fulfil our expectations. We can but assign to them an uncommon importance; for it is indeed significant, that the novel duty of recording the biological history of ourselves, our parents, and our children, is thus made easy to us by Mr. Galton. It is mainly to his influence that we must trace the conviction of thoughtful and earnest minds that it is really a duty to record the characteristics of every

individual and family; for Mr. Galton, more than any one else, has brought home to us the fact of our close dependence upon our ancestors for our traits of body, mind, and character. Mr. Galton's two small volumes provide most admirably for the facts in individual cases. The thicker of the two, the life-history album, will undoubtedly be the most widely used. It provides for the systematic record of the principal facts which may serve to indicate the constitutional character and the course of development of an individual from birth to seventy-five years of age. Directions, admirable in clearness and simplicity, are prefixed to the volume. The first of the blank tables that follow is for a brief genealogical record; the second, for the description of the child at birth. The remainder of the record is divided into five yearly periods. For each period the headings and blanks are repeated, so that the same qualities may be traced through all their changes. The data to be entered are of four kinds: first, physical characteristics, the stature, complexion, acuteness of the senses, etc.; second, other peculiarities, bodily endurance, recent trial of mental power, artistic capacity, resemblance to relatives; third, photographs in profile and full face; fourth, any other observations, including especially the full medical history. There are also charts on which to record graphically the growth; and these charts also give the curves of average growth for males and females. At the end of the volume are a few pages for records of the wife (or husband) and children. An appendix gives tests for vision.

Only those having experience can appreciate the study and thought which have been expended upon this remarkable album, — the product of a noble and wise philanthropy. Parents who earnestly desire their children's welfare will gradually learn to recognize the necessity of profiting by Mr. Galton's guidance in preserving a knowledge of their children's lives, for the plan which he has formulated can hardly be improved at present. Such knowledge is valuable to the child, not only as indicating its constitutional tendencies, but also often as giving warning of incipient disease, and as revealing the influence of change in residence, occupation, diet, or habits, upon health. More valuable still will the accurately kept album be when the child becomes a parent.

"For mental and physical characteristics, as well as liabilities to disease, are all transmitted more or less by parents to their children. . . . The world is beginning to perceive that the life of each individual is in some real sense a prolongation of those of his ancestry. His character, his vigor, and his disease are principally theirs. . . . The life-histories of our relatives are, therefore, more instructive to us than those of strangers: they are especially able to forewarn and encourage us, for they are prophetic of our own futures."

The thinner volume is designed especially to further the science of heredity by gathering histories of families. It is arranged to contain brief records of the principal traits, bodily and psychic, of a person, and the person's parents, grand-parents, great-grand-parents, and children. Those who are able to do so, can render a valuable service, not only to themselves, but also to knowledge, by filling out accurately a record of their family faculties, and transmitting a duplicate to Mr. Galton, who will use it as a confidential document for statistical purposes only. That he will draw most valuable deductions from such materials, those who know his earlier researches are convinced beforehand. The album of family faculties has the same general plan and excellences, and deserves the same general praise, as the life-album.

Of the laws of heredity, but little is really known; but, when they are better and more generally understood, a great revolution must ensue in human society. Mr. Galton is laying the foundation of a thorough knowledge of heredity; and, because imagination hastens to conceive the future changes that may result, we are inclined to designate Mr. Galton's two recent publications as the most important books of the year. But in such matters, wisdom may be boldness in theory, but must be conservatism in practice: therefore let us diligently gather knowledge of heredity, and meanwhile postpone the anticipated revolution.

To all persons we earnestly recommend the faithful use of the two volumes we have reviewed.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Fulgurite from Oregon. — During Mr. Diller's reconnoissance of the Cascade Range in the summer of 1883, Mr. E. E. Hayden collected from the summit of Mount Thielson, one of the sharpest and most precipitous peaks in the Cascade south of the Columbia, specimens of fulgurite, the product resulting from the

fusion of rock-masses by lightning. The greater portion of Mr. Diller's time in April was devoted to the study of this rock, which was deemed worthy of special examination, not only on account of its rarity, but also from the fact that it presents the opportunity to study the products of an uncommon method of fusion. While the formation of fulgurite in sand is of frequent occurrence, it is only exceptionally produced in solid rock. The most important locality where it has been heretofore discovered in solid rock is Little Ararat in Armenia reported by Abich. Upon the specimen collected by him, Wichmann has made a brief microscopical research. An endeavor is being made to obtain some of the fulgurite of Little Ararat for comparison with the Oregon specimens.

Saussure mentions glazed hornblende schist as occurring on the summit of Mont Blanc; Humboldt reports fulgurite from one of the peaks in Mexico; Ramond saw it at several points in the Pyrenees and the Auvergne: but these occurrences have never been investigated.

Mr. Diller prepared a number of delicate, thin sections of the fulgurite from Mount Thielson; and its relation to the various constituents of the rock has been very clearly made out. A chemical analysis has been made by Prof. F. W. Clarke.

The material fused by the lightning was cooled so quickly that it all remained amorphous, and formed a dark, porous glass. In order to test the conclusions reached in the microscopical analysis, an attempt was made to crystallize the fulgurite. A completely amorphous fragment was heated without fusion in a Bunsen lamp for six hours, and then found, in polarized light, to be made up of strongly doubly refracting fibres, with a marked tendency to spherulitic arrangement. A finely pulverized portion was fused, and as highly heated as possible in a blast-lamp for four hours and three-quarters, and then allowed to cool gradually. Under the microscope, it was found that much of the felspar, some pyroxene, and many undeterminable microlites, crystallized out of the glass during the heating. The various stages in the development of felspar crystals from more or less regular groups of microlites, through lathe-shaped bundles of fibres to a completely clear, transparent crystal, are easily traced. The microscopical as well as the chemical evidence, and that derived from the re-crystallization of the fulgurite, all indicate that the fusion was confined chiefly to the siliceous groundmass of the rock with which the fulgurite is associated. The rhombic pyroxene was also fused to some extent, while the plagioclase felspar and olivine were not affected. The examination also indicates that the composition of the glass derived from the fusion of parts of a heterogeneous rock is a function of the fusibility and electric resistance of its various constituents.

The basaltic rock on which the fulgurite has been found is unique in the character of its pyroxene. The various mineral constituents of the rock are now being separated, for the purpose of a chemical analysis, by means of Thoulet's solution.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Brooklyn entomological society.

May 31. — Mr. Roberts gave an account of the habits of the Elmidae, a large number of which were collected by him at the Clifton excursion. —— Mr. Schwensen called attention to the food-habits of some species of the Chrysomelidae, belonging or allied to Cryptocephalus. Many species are, in his experience, omnivorous; others, found only on certain groups of plants.

Academy of natural sciences, Philadelphia.

May 20. — Mr. Joseph Willcox stated, that, on the west coast of Florida, shell-mounds are very numerous, indicating the former favorite camping-grounds of Indians. The largest accumulation of shells is at Cedar Keys. A portion of the town is built on the mounds; and great quantities of the material, consisting almost entirely of oyster-shells, have been used in grading the streets. Human bones, stone implements, and fragments of pottery, are frequently found among the shells. Although Professor Wyman, in his memoir on Florida shell-heaps, asserts that stone chips are not common, being only found separately or a few together, and in no case indicating a place for the manufacture of arrow-heads or other implements, such a place of manufacture may be seen on John's Island, at the mouth of the Cheeshowiska River. Several bushels of chips are here scattered about, all made of the chert rock, the only material in Florida suitable for the purpose. —— Professor Heilprin, referring to the Foraminifera found in the rock-masses from Florida, stated, that, after a careful search, he had been able to add but one genus, Spheroidina, to those before enumerated. It was, he believed, the first time that any of the genera named at the meeting of April 22, except Orbitoides, had been discovered in America. He had also found another species of Nummulites, making, with N. Willcoxii, the second American form. The new species is twice the size of that named; and the septa are more numerous, and bent at a more acute angle. Two additional forms of Orbitoides had been determined, the presence of one of which, O. ephippium, places beyond doubt the oligocene age of the deposits containing it. —— Mr. Thomas Meehan exhibited flowers of the remarkable Halesia, the striking variation in the leaves and seeds of which had formed the subject of a former communication. The flowers of the sport are cup-shaped instead of tubular; and the wide divergence reached without any intervening modifications was another illustration of the fact that the maxim of

Ray, '*Natura non facit saltum*,' needed modification. He had noticed that such departures usually occur in different parts of the country at the same time. The common calla lily, for instance, had, in several cases during the present season, developed a spathe some four inches below the perfect flower: in other words, the usually naked flower-scape of the Richardia had borne a bract. Flowers with a pair of more or less imperfect spathes were not uncommon in some seasons; the peculiarity of the cases now referred to being the interval of several inches on the stem, which justifies the application of the term 'bract' to the lower spathe. Numbers of such specimens had been brought to him from the neighborhood of Philadelphia, while others had been sent from Ohio, Indiana, and Illinois, hundreds of miles apart. In view of such circumstances, he believed that varieties might spring from widely separated centres by the operation of a general law entirely independent of environment. We know that distinct forms do spring through single individuals from seed, and that, after struggling successfully with all the vicissitudes of its surroundings, the new form may succeed in spreading, through the lapse of years or ages, over a considerable district of country. But the idea, that always and in all cases species have originated in this manner, presents occasionally difficulties which seem insurmountable. In the case of the similarity between the flora of Japan and that of the eastern portion of the United States, we have to assume the existence of a much closer connection between the land over what is now the Pacific Ocean, in comparatively modern times, in order to get a satisfactory idea of the departure of the species from one central spot, and to demand a great number of years for some plants to travel from one central birthplace before the land subsided; carrying back species in geological time farther, perhaps, than geological facts would allow. But if we can see our way to a belief that plants may change in a wide district simultaneously in one direction, and that these changes, once introduced, may be able to perpetuate themselves till a new birth-time should arrive, we have made a great advance towards simplifying the problem. —— Mr. Edward Potts stated that a correspondent in Jamaica had failed to find there a single species of fresh-water sponge. It had been suggested that these organisms affect higher latitudes and elevated regions, — an opinion which the speaker was disposed to hold. In all the water-pipes examined by him, from the immediate vicinity of the basin, he had found abundant sponge-growth; and it had been asked if such growth might not be a cause of obstruction. In some sections of filled-up pipes, taken at a greater distance from the supply, he had found no sponge; the blocking substance being clay with iron impregnation. He had found, that, where masses of Mayenia Leidyi were strongly mixed in these pipes with iron, the skeleton spicules had undergone a curious change. In nearly all spicules, especially when young, a fine line can be traced down the middle; but, in the specimens referred to, a clear channel occupying two-thirds of the entire space, with openings at the ends, could be observed. It was suggested that the change was due to the iron retarding the deposit of siliceous matter in the central channel of the spicules. In the birotulate spicules of the same masses the margins of the disk-like ends were eliminated, leaving them in the form of rays.

Davenport academy of natural sciences, Iowa.

May 30. — Mr. W. H. Pratt called attention to some interesting peculiarities in several of the flathead skulls from the Arkansas mounds, in one of which appears a large 'Inca bone,' formed by the presence of a horizontal occipital suture in addition to those usually present; and in another the ear-openings are nearly closed by the bones growing into them. He also exhibited a number of ossicles — minute bones of the internal structure of the ear — which had been extracted in cleaning out the earth which filled the cavities. —— The honey-dew, which has been observed in such remarkable profusion this season, and the various opinions regarding its origin, came up for discussion; and twigs from several trees were presented for examination. The observations of several members seemed strongly to support the theory that the substance is, partly at least, produced by the bark-louse, Pulvinaria innumerabilis, and perhaps kindred species. This opinion was sustained by the following facts: 1°. It is found that the honey-dew is not deposited on the leaves at the top of the trees, hence is not an exudation from the leaf. 2°. It is not found on the white maples which are not infested by the bark-louse, several instances of which have been noticed. 3°. It is observed to a less extent on the box-elder tree; and on examination it is found that that tree is also infested by the Pulvinaria, though not so badly as the maple. 4°. It is observed that the honey-bee, which collects the honey-dew with great avidity, very often, and especially when the substance is considerably dried and hardened upon the leaves, proceeds directly to the under side of the limb, where the insects are fixed, and, running along the branch, examines them carefully, apparently seeking its supply from that source. 5°. It is also observed that there is always more or less of it upon the insects, especially in the morning; and, upon close examination, all are found to contain a quantity of the same substance. In view of these facts, the opinion was expressed, that, although further and thorough investigation is necessary to establish the fact, this will be the final solution, — that the honey-dew is largely the product of the Pulvinaria, the sap being by it extracted from the tree, and elaborated by the insect organism into this sweet substance, as is a similar or perhaps identical substance by some of the Aphides, and honey by the honey-bee.

Natural history society, Cornell university, Ithaca, N.Y.

May 29. — Mr. C. S. Prosser read a paper on silver in the Chemung and Catskill, the principal part of which was devoted to a consideration of the recently discovered silver-deposits near Oneonta, Otsego county, N.Y. It is claimed that valuable deposits of gold and silver have been found in the Catskill

or Chemung near Oneonta, and that, according to assays, the rock will yield per ton from fifty to a hundred and ninety-five dollars of gold and silver. In this paper the result of a series of assays was given, and no one indicated more than three dollars of silver to the ton of ore. There is in some of the rock a small amount of galena; and in this, from one to two ounces of silver in a ton of ore, but not any gold.

Society of arts, Massachusetts institute of technology.

May 8. — Prof. Edward C. Pickering addressed the society on the proper method of measuring colors. After referring to the difficulty of measuring color and in obtaining a proper unit for measurement, the speaker referred to the ordinary phenomena of color, and the effect of various bodies on the rays of light; dwelling, among other things, upon the effect of a large index of refraction in increasing the brilliancy of a body. The explanation was suggested, that the increased brilliancy of the so-called straw diamonds, so lately the subject of comment, and which were said to have been made of glass and painted, might have been due to a deposit upon them of a very thin layer of silver. The speaker said that the subject of color had generally been studied subjectively, that is, by its effect on the eye, and not objectively, as a phenomenon in itself. The generally accepted theory of color was explained, by which it is supposed that the eye can distinguish three primary colors, — red, green, and a bluish violet; and the objections to the use of Chevreul's color-circle as a means of measuring and distinguishing color were referred to. By the objective method of studying color, we may determine the intensity of each portion of the spectrum by a thermopile or bolometer, or by photography, or, again, by means of the instrument proposed by Vierordt, by which the lower half of the slit of a spectroscope can be varied in width until any part of the corresponding spectrum shall be just equal in brightness to that coming from the upper half of the slit, through which is passed the light to be measured. The amount of opening of the lower half of the slit affords an invariable scale for the measurement of the relative intensity of two lights. Professor Pickering had experienced numerous difficulties in experimenting with Vierordt's instrument, especially when the lights differed greatly in intensity. The photo-spectroscope which he had finally perfected was exhibited and described. It consists of a spectroscope with two slits, in which the relative intensities of two spectra may be measured by polarized light. Special devices were employed to render the images to be compared well defined on their edges, and of uniform brightness. The instrument allows of many practical applications in the measurement, by absolute standards, of paints, dyes, inks, glass, and the comparison of lights from various sources. Another application is to the measurement of the colors of stars, the chief difficulty being lack of light. In this measurement, Professor Pickering had modified the method of Professor Pritchard, who had compared the light of different stars by extinguishing them with a wedge of shade-glass, measuring by a scale the point at which they ceased to be visible. Professor Pickering had measured the relative intensities of the different colors by spreading out the light of the star into a spectrum, and allowing the star to transit along the wedge, the time of disappearance of each color being noted. The exact color is determined by a series of slits. All the spectra are brought into the same position by an auxiliary image brought into the field by means of a plate of plain glass cemented to the side of the principal prism. The results given by this instrument are very encouraging, and promise to give a satisfactory measure of the intensity of each part of the spectrum of the stars.

Biological society, Washington.

May 3. — Dr. R. W. Shufeldt remarked in the course of his description of a pair of ribs on the occipital bone of the large-mouthed black bass, Micropterus salmoides, that recently he had made a number of dissections of this fish, and in every instance had found a pair of ribs upon the occipital bone, just above and internal to the foramen of the vagus nerve (see *Science*, Nos. 65 and 69). They are without epipleural appendages, but otherwise like the abdominal ribs. If this fact be new to science, it is a very interesting discovery, of great morphological significance, and introduces an important factor in the theory of the segmentation of the skull. It had not been noticed in any of the prominent works upon comparative anatomy generally used as text-books, nor in a recent and very thorough article by Dr. Sagemehl upon the cranial osteology of Amia caloa (*Morph. jahrb.*, 1883). Dr. Shufeldt had also discovered these ribs thoroughly developed in the tunny, Orcynus thynnus, and thought that they would doubtless be found in others of the Scombridae and Centrarchidae. —— Dr. T. Gill briefly reviewed the salient structural features of the various representatives of the order Squali, as well as the history of the classification of the group, and claimed that there were five principal types of structure manifested in the various forms, whose anatomy is more or less satisfactorily known: 1°, the Pternodonta, or Selachophichthyoidi, represented by but one known species, lately described by Mr. Garman (*Science*, No. 52); 2°, the Opistharthri, of which the Notidanidae or Hexarchidae are the only known forms; 3°, the Proarthri, of which the Heterodontidae, represented by the well-known 'Port Jackson shark,' forms the only existing family; 4°, the Anarthri, to which belong all living sharks excepting those now specifically eliminated; and, 5°, the Rhinae, to which belong the family Squatinidae, including the so-called 'angel-sharks.' The speaker was inclined to consider several of these more than sub-ordinal, and rather as of ordinal value; but, until they had been better studied, he would reserve opinion on this question. There was one type, represented by the extinct Cladodontidae, whose position was doubtful. For these he had formed the group Lypospordyli; but it was not evident whether it belongs with the true Squali, or whether it may not be related to the Holocephalus, the character of the branchial arches being dubious. —— Mr. N. P.

Scudder exhibited specimens of muskrat skeletons, showing the number of the lumbar vertebrae to be six, and not three, as stated by Professor Flower. He also showed that the malar bone formed part of the continuity of the zygomatic arch; correcting the statement of Dr. Coues, in his 'Monograph of American Rodentia,' p. 253, with regard to the jugal of the muskrat, which is there described "as a mere splint, not forming by itself any part of the continuity of the arch, for the squamosal and maxillary spurs are absolutely in contact. This is a strong point of Fiber." Mr. Scudder remarked that muskrats were enabled to live from four to six minutes under water; owing, probably, to the enlargement of the abdominal *vena cava*, which extended over the abdominal aorta. He believed muskrats to be omnivorous, and said that the same individual could be taken repeatedly in the same trap.

May 17.—Dr. J. M. Flint gave a brief account of the history of medicine among the Chinese according to their own authors, and then discussed their theories in regard to the nature and causes of disease, and the action of remedies. Their ignorance of anatomy, and the consequent effects upon their theory and practice, were shown. The materia medica of the Chinese was then considered in detail, and its peculiarities, as well as its resemblances to our own present and past, as illustrated by the collection of Chinese drugs now in the possession of the National museum. ——Mr. Wiley Britton sent a paper on the buffalo gnat of Tennessee, in which he stated that its habitat was confined to the Mississippi valley, below the mouth of the Ohio River. The flies generally make their appearance about the first of April, and remain from two to four weeks. They destroy annually more or less live-stock, particularly mules and horses; which, however, could be protected by thorough greasing. The bite of this gnat is poisonous, causing a swelling somewhat like a bee-sting. ——Dr. T. H. Bean, in a paper on the white-fishes of North America, said there were twelve species indigenous to North America, besides the Inconnu, which is not properly a white-fish, though related to it. He made a few general remarks concerning the wide distribution, great abundance, and importance of the white-fishes as food, and stated the range of each species, its maximum size and weight, and its variations through age and conditions of habitat. A brief key to the species, intended to facilitate their speedy identification, and based upon natural characters only, was included in the paper. ——Dr. Thomas Taylor exhibited a new instrument, a micrometer, of his own invention, for measuring accurately and instantly to the $\frac{1}{2000}$ inch the thickness of any object. He also explained that pseudo-bacteria were produced by the heating of blood at a comparatively low temperature, and proposed to make experiments for the purpose of deciding whether a continuous fever of four or five days, with the blood at 104°, would produce the same results as blood artificially heated to 110°. If so, it would account for mistakes that have been made by persons inexperienced in examining the blood of fever patients, who report the presence of bacteria when it was simply pseudo-bacteria, or broken blood-corpuscles, as shown by Beal and others. He further explained a method of throwing upon a screen the circulation of blood in a frog's foot, the magnification depending upon the distance of the reflecting object, using the high powers of the microscope on the principle of double sight.

NOTES AND NEWS.

ALONG the eastern verge of the Bahamas, somewhere in that skirmish-line of islands consisting of Cat, Watling's, Samana, Mariguana, and Turk's, Columbus made his landfall. Each has had its advocates; and the late Gustavus V. Fox, in 1880, in a report of the coast-survey, maintained the claim of Samana, which at that time was the only one possible, that had failed of an advocate. His arguments are now reviewed, and the whole question examined afresh, by Lieut. Murdoch of the navy, in a paper just printed in the proceedings of the U. S. naval institute. He claims for Watling's, which has had some strong supporters since it was first named by Muñoz in 1793. It is believed to be the landfall by Capt. Becher of the royal navy, who has printed the most considerable monograph on the subject; and such leading students of our earliest history as Major among the English, and Peschel among the Germans, have also been its advocates. The question is never likely, however, to be set at rest, unless contemporary documentary evidence, not now known, comes to light. We have nothing but Columbus's own journal to guide us, and a part of that only in abstract as Las Casas made it. No theory can satisfy all the conditions which it prescribes; and those which can be satisfied do not seem to pertain exclusively to any one point, as the variety of views clearly shows. Watling's may be said to receive the support of the greatest number of authoritative critics; and nothing more conclusive can be held to have been attained.

— In an article in the June *Century*, entitled 'What is a liberal education?' (noticed in an earlier part of this number), President Eliot of Harvard thus speaks of the place of natural science in a liberal scheme of study: —

The last subject for which I claim admission to the magic circle of the liberal arts is natural science. All the subjects which the sixteenth century decided were liberal, and all the subjects which I have heretofore discussed, are studied in books; but natural science is to be studied, not in books, but in things. The student of languages, letters, philosophy, mathematics, history, or political economy, reads books, or listens to the words of his teacher. The student of natural science scrutinizes, touches, weighs, measures, analyzes, dissects, and watches things: by these exercises his powers of observation and judgment are trained, and he acquires the precious habit of observing the appearances, transformations, and processes of nature; like the hunter and the artist, he has open eyes and an educated judgment in seeing; he is at home in some large tract of nature's

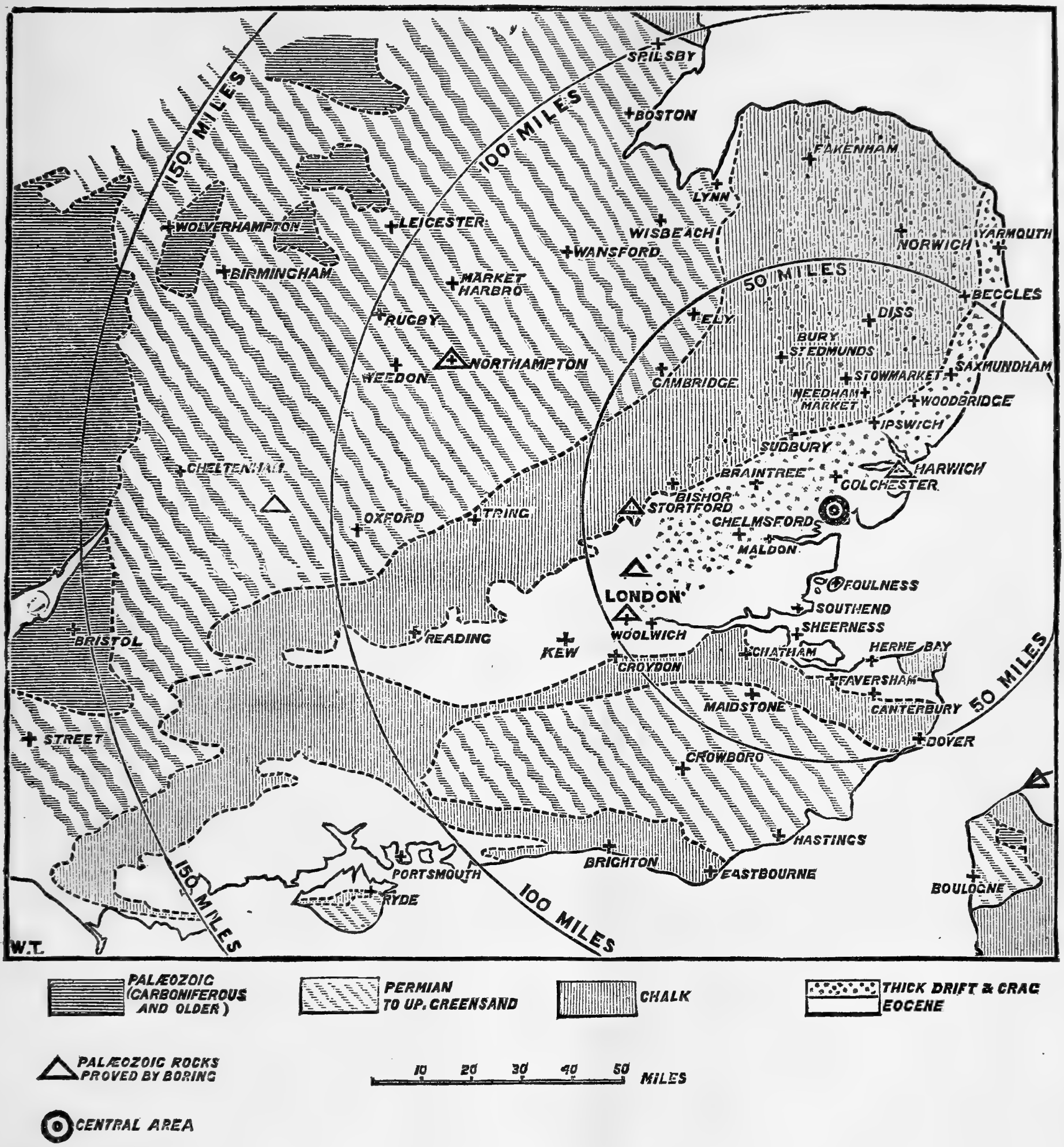
domain; finally, he acquires the scientific method of study in the field, where that method was originally perfected. In our day the spirit in which a true scholar will study Indian arrow-heads, cuneiform inscriptions, or reptile tracks in sandstone, is one and the same, although these objects belong respectively to three separate sciences, — archeology, philology, and paleontology. But what is this spirit? It is the patient, cautious, sincere, self-directing spirit of natural science. One of the best of living classical scholars, Professor Jebb of Glasgow, states this fact in the following forcible words: "The diffusion of that which is specially named science has at the same time spread abroad the only spirit in which any kind of knowledge can be prosecuted to a result of lasting intellectual value." Again: the arts built upon chemistry, physics, botany, zoölogy, and geology, are chief factors in the civilization of our time, and are growing in material and moral influence at a marvellous rate. Since the beginning of this century, they have wrought wonderful changes in the physical relation of man to the earth which he inhabits, in national demarcations, in industrial organization, in governmental functions, and in the modes of domestic life; and they will certainly do as much for the twentieth century as they have done for ours. They are not simply mechanical or material forces: they are also moral forces of great intensity. I maintain that the young science, which has already given to all sciences a new and better spirit and method, and to civilization new powers and resources of infinite range, deserves to be admitted with all possible honors to the circle of the liberal arts; and that a study fitted to train noble faculties, which are not trained by the studies now chiefly pursued in youth, ought to be admitted on terms of perfect equality to the academic curriculum.

The wise men of the fifteenth century took the best intellectual and moral materials existing in their day, — namely, the classical literatures, metaphysics, mathematics, and systematic theology, — and made of them the substance of the education which they called liberal. When we take the best intellectual and moral materials of their day and of ours to make up the list of subjects worthy to rank as liberal, and to be studied for discipline, ought we to omit that natural science which in its outcome supplies some of the most important forces of modern civilization? We do omit it. I do not know a single preparatory school in this country in which natural science has an adequate place, or any approach to an adequate place, although some beginnings have lately been made. There is very little profit in studying natural science in a book, as if it were grammar or history; for nothing of the peculiar discipline which the proper study of science supplies can be obtained in that way, although some information on scientific subjects may be so acquired. In most colleges a little scientific information is offered to the student through lectures on the use of manuals, but no scientific training. The science is rarely introduced as early as the sophomore year: generally it begins only with the junior year, by which time the mind of the student has become so set in the habits which the study of languages and mathematics engenders, that he finds great difficulty in grasping the scientific method. It seems to him absurd to perform experiments, or make dissections. Can he not read in a book, or see in a picture, what the results will be? The only way to prevent this disproportionate development of the young mind, on the side of linguistic and abstract reasoning, is to introduce into school courses of study a fair amount of training in sciences of observation. Over against four languages, the elements of mathematics, and the elements of history, there must be set some accurate study of things. Were other argument needed, I should find it in the great addition to the enjoyment of life which results from an early acquaintance and constant intimacy with the wonders and beauties of external nature. For boy and man this intimacy is a source of ever fresh delight.

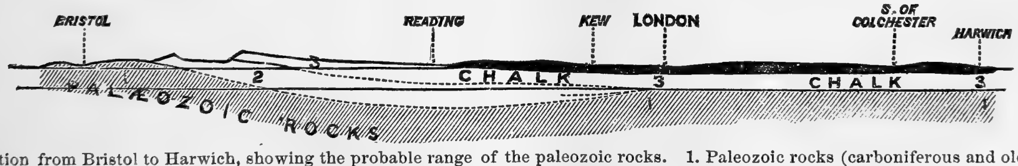
— Some questions having been raised in relation to the distance travelled by the Lapps of Baron Nordenskiöld's party in their excursion into central Greenland, Mr. Oscar Dickson arranged for a series of races on *skidor* ('snow-shoes') at Quickjock in Lapland. The distance which they claimed to have travelled over the Greenland ice was two hundred and thirty kilometres, going and returning in fifty-seven hours. For this reason the courses were arranged so as to have a total length of two hundred and twenty-seven kilometres. The races took place on the 3d of April last, and were spread over six days. The following results were obtained: —

The first prize, three hundred and fifty francs, was gained by Pavo Lars Tuorda, one of those who had visited Greenland with Nordenskiöld, and who travelled over the above-mentioned distance in twenty-one hours twenty-two minutes, including all stoppages. The second prize was gained by Pehr Olof Ländta, who came in half a minute later. The third and fourth prizes were awarded for the times of twenty-one hours thirty-three and a half minutes and twenty-one hours and fifty-six minutes respectively. Four others received a gratuity of thirty-five francs for having covered the distance in less than twenty-six hours. All arrived in good condition, unexhausted, and took part in the festivities which followed the races. Many of them had also travelled from seventy to a hundred kilometres before the race, to get to the point where the course began. It will be observed that the result completely confirms the claims of the Lapps on their journey in Greenland, as far as a parallel performance can do so.

— In an article in *Nature* of May 15, upon the recent earthquake in England, Mr. W. Topley gives a map of the affected district in which an attempt has been made to mark the positions of all places at which the shock was felt, so far as can be learned from published accounts; but in Essex, Suffolk, and North Kent, only a few of such places could be marked. By marking the outcrops of the older rocks (carboniferous and earlier), the possible connection of these with the travel of the earthquake-wave may be seen. This is made clearer by the section. The position of the



Map of the earthquake of April 22, 1884. N.B. — The places marked are those at which the shock was felt. In the east of England only the more important of such places are marked.



Section from Bristol to Harwich, showing the probable range of the paleozoic rocks. 1. Paleozoic rocks (carboniferous and older); 2. Permian to upper greensand; 3. Chalk.

paleozoic rocks is known at Harwich and London. There is some uncertainty as to their position under Reading and Colchester; but for the purpose intended, and regard being had to the depth at which the shock must have originated (certainly far within the paleozoic rocks), the line drawn is sufficiently near the truth. We can see how the shock can have been propagated through the hard paleozoic rocks, and

been felt where these are bare or thinly covered with newer rocks; whereas, through the thick and softer secondary and tertiary rocks, the wave might travel a shorter distance. Possibly, also, this section may suggest an explanation of the double shock which was sometimes recorded: the first would be that travelling quickly through the hard paleozoic rocks; the second, that propagated more slowly through the softer overlying newer rocks.

— The Niger expedition, sent out by Dr. Emil Riebeck of Halle, is to devote itself especially to linguistic and ethnographical exploration; and the first report of its work has just appeared, under the title "Ein beitrag zur kenntniss der fulischen sprache in Africa, von Gottlob Adolf Krause," — an octavo pamphlet of a hundred and eight pages, with a map of the region explored, published by Brockhaus, Leipzig. The name of the people whose language Mr. Krause has studied is variously spelled. They call themselves in the singular, Pul; in the plural, Ful (the change of the initial consonant is in accordance with a euphonic law of the language); the French usually write the name Poul, and this form has been adopted by some English writers; but the Arabs and other neighbors more commonly employ the other: and it therefore seems better to call the people Fuls, and their language the Fulic. This people, spread over a large part of western and middle Sudan, with a territory about one-fourth as large as Europe, has been long recognized as one of the most interesting on the continent of Africa. They are clearly distinguishable, in physical and mental characteristics, from the negroes south and west of them, and are perhaps allied in degree of culture, and in language, to the Cushite tribes who dwell in and near Abyssinia. There are found among them both the brown-red type and the black. They are not massed in one community, but are settled in groups, with various occupations, — some peaceful and industrious, others warlike and predatory. Whence and when they came to their present abode is not known: their traditions are either not clear, or are evidently affected by their contact with the Arabs and other Mohammedans. But, from the few historical accounts which have been collected by European travellers, we learn that the Fuls have been a conquering people for centuries. The first reliable mention of them occurs in the thirteenth century of our era, at which time they had already established a kingdom. At the present time two Ful kingdoms are in existence, — that of Sokoto, and that of Gando; and their conquering career still continues. They have long since embraced Islam, are zealous students of the Kuran, and have begun to create a national literature. One of the most interesting facts in the history of the North-African peoples is the readiness and intelligence with which they have accepted Islam; and there is no doubt that they have been greatly benefited by its literary and ethical culture. The Fulic language has no distinction of genders (according to Gen. Faidherbe, it distinguishes human beings from the lower animals in its noun-termination), and no declension of nouns; but, on the other hand, it has a very elaborate development of the verb. In this latter point, and in its pronominal forms, it seems to approach the Galla and other Cushic tongues, and even the Semitic. But these comparisons must be conducted very cautiously. The differences between the groups of languages in question are greater than their resemblances; and, if Semitic and Hamitic (that is, Egyptian, Libyan, and Cushic) ever formed one family, it was so long ago that the demonstration of their unity must be next to impossible. Mr. Krause compares some of the forms of these groups, and reaches the conclusion that the Fulic is to be regarded as proto-Hamitic; that is, as representing the original linguistic type from which Egyptian, Libyan (Berber), and Cushic have sprung: but this conclusion is not justified by the facts. Mr. Krause has done his work of exploration well; and it is to be hoped that he will be able to continue his investigations, and clear up some points in the Fulic language and history which are still obscure.

— *Nature*, May 29, states, that last autumn the expedition under Lieut. Holm for exploring the east coast of Greenland, and which is again to start northwards this spring, met a party of about sixty East-Greenlanders — men, women, and children — south of the island of Aluk, on the east coast. They were on the way to the west coast to sell bear, fox, and seal skins. Every attempt was made by the Danish explorer to induce some of them to return, and act as guides on his journey northwards; but the prospect of a visit to a Danish settlement proved too great. A considerable number of East-Greenlanders die on their way to the west coast. The East-Greenlanders are reported to differ much from the West-Greenlanders in stature and appearance; the men being often tall, with black beards and European cast of face. This seems to be particularly the case with those living far north. Both East and West Greenlanders have small hands and feet. During the year 1883, four boats with heathen East-Greenlanders arrived at Julianshaab. Three of these came from the distant Angmasalik; and in them there were also, for the first time, natives from Kelalualik, which is five days' journey farther north. The latter stated, that in the winter they were in the habit, when journeying on sleighs, of meeting with people living much farther north. Kelalualik being situated, it is believed, between latitude 67° and 68° north, it may be assumed that the whole line of coast from latitude 65° to 70° is to some degree populated.

— A note from Mr. Jurgens of the Lena international meteorological station says that the work there will terminate about the middle of June. The party will then proceed in boats to Yakutsk, where they hope to arrive in August. This letter, dated Nov. 13, says, that, during the summer of 1883, four hundred and fifty versts of routes in the Lena delta had been surveyed, and magnetic observations made at five different localities. The mean temperature of June, July, and August, was about 36° F. The Lena was closed by ice Sept. 19. During the summer the sky was constantly cloudy, with light winds accompanied by fog.

— The physical control of the character of sediments described by Rutot (see *Science*, 1883, ii. 560) is now considered by another Belgian geologist, Van den Broek, as the basis for a new style of classification of certain geological deposits; namely, for those fragmental strata, accumulated around the margin of oceanic areas, in which the alternation from coarse to fine sediments shows a variation in the depth of the water in which the accumulations were made. The work is an extension of the idea so well presented in Professor Newberry's 'Circles of deposition' some years ago.

— A meeting was held in Boston recently, at the rooms of the American academy of arts and sciences, to consider the advisability of forming a New-England society for observation and study of meteorology. Prof. W. H. Niles of the Massachusetts institute of technology was elected chairman, and Mr. W. M. Davis of Harvard college, secretary. After an informal discussion of the method and aims of such a society, a committee, consisting of Professor Winslow Upton of Brown university, Professor Arthur Searle of the Harvard college observatory, and Mr. Davis, was appointed to consider further plans for organization and work, and to report at a meeting to be called at an early date.

— *Cosmos les mondes* gives the following description of the Skrivanow pocket-battery. The element is constructed of sheet zinc and silver chloride wrapped in parchment paper, immersed in a solution of seventy-five parts of caustic potash, and a hundred of water. The whole is placed in a small trough of gutta-percha, which can be closed hermetically. The conductors and external contacts are of silver. Such an element, when complete, weighs about a hundred grams. Its electromotive force is 1.45 to 1.50 volt, and it yields for an hour a current of one ampère.

— Mr. Richard Jones, who has for many years devoted his attention to the preservation of meat, has now adopted a new process. The principle consists in the injection of a fluid preparation of boracic acid into the blood of the animal immediately after it has been stunned, and before its heart has ceased to beat; the whole operation, including the removal of the blood and chemical fluid from the body of the animal, only taking a few minutes. The quantity of boracic acid used is very small, and that little is almost immediately drawn out again with the blood. The preservation of the flesh is said to be thoroughly effected: the quantity of the chemical left in the flesh must therefore be very small, and can scarcely be injurious to the human system; for, as Professor Barff has proved by experiment, living animals, either of the human or other species, do not seem to be injured in any way by the consumption of it. A demonstration of the effects of the process was given in April at the Adelphi Hotel, when the joints cut from a sheep that had been hanging for more than seven weeks at the house of the Society of arts were cooked in various ways; and those present agreed that the meat was equal to ordinary butcher's meat.

— Mr. G. F. Kunz exhibited, at a recent meeting of the New-York academy of sciences, two ancient images of the llama and vicuna from the interior of Peru. They weighed six ounces each, and were both of solid silver, with the exception of the bodies, which were filled with some earthy material. The llama had evidently been acted upon by substances in the soil, which left the silver in a remarkably pure state; and the workmanship on this figure, especially the hair reproduction, was very fine. The vicuna is not of so pure silver, and is in a very good state of preservation. Mr. Kunz explained that a famine in the interior of the country had caused the graves to be despoiled of many thousand ounces of ornaments, which were carried to the seacoast, and there sold for their weight in silver and gold.

— It is said that a wild-flowers protection act has been introduced in the British house of commons, by the provisions of which any one, for twenty years to come, found grubbing up a fern, primrose, violet, or in fact any of the indigenous blossoms, shall be subject to fine and imprisonment. The inhabitants of Cornwall and Devonshire, those lands of fern, have been advertising largely their willingness to denude their own counties to supply the cities, — a process made easy by the parcel-post.

— The success of the late international exposition at Amsterdam has tempted the Colonial society of the Netherlands to propose the establishment of a periodical in French and Dutch, under the name of the *Revue coloniale et internationale*, in which those interested, of whatever nationality, can discuss with freedom any questions relating to colonial affairs. It is proposed to divide the contents into three sections, relating respectively to commerce and industry, government, and geography and ethnology. The support of geographers, in general, is requested toward the carrying-out of this programme.

— Some English tourists, including Mr. Graham of the Alpine club, have engaged two guides from the Bernese Oberland, and proceeded to India with the intention of scaling some of the high peaks of the Himalayas, especially Kabru (23,000 feet) and Zubanu (21,000 feet). For the present they will not attempt Mount Everest.

— We learn from *Nature*, May 29, that the French minister of education and the fine arts has proposed to place at the disposal of Pasteur, for the prosecution of his scientific experiments, a large domain situated at Villeneuve-Etang, which belongs to the state.

— Bove, after a short excursion on the Upper Parana, was to embark for the Falkland Islands and Tierra del Fuego. He expects to visit Italy this summer, and make preparations for an antarctic expedition projected for the year 1885.

— Widdeman, a French chemist, has observed that an insulating-skin can be produced on metal wires by decomposing plumbates and alkaline ferrates with the electric current. The method is as follows: prepare a bath of plumbate of potash by dissolving ten grams of litharge in a litre of water, to which two hundred grams of caustic soda has been

added, and boil it during half an hour. Let it rest, decant, and the bath is ready for use. The wire to be covered with the insulating-skin is connected to the positive pole of the battery, and a small strip of platinum to the negative pole. Both wire and platinum are then plunged in the bath. Metallic lead in a very divided state is precipitated at the negative pole, and peroxide of lead on the wire. This layer of peroxide takes all colors of the spectrum, and the insulation is highest when the wire takes a brownish-black tint. If this insulator is durable, it will prove of great service in electric lighting.

— The Society of naturalists of the St. Petersburg university have decided on affording means to three zoölogists for expeditions in 1884. One is to study the fauna of the White Sea; another, the embryology and development of the genus Accipenser in the Ural River. The botanical and geological excursions will be discussed later on.

— On May 19 Pasteur read, at the Academy of sciences, his report on his four years' experimental studies on hydrophobia, and the means, not of eradicating, but of weakening it. The correspondent of the London *Daily news* describes Pasteur as "a man of square-built figure, and having the rather coarse and solid air which one so often finds in aristocrats and peasants in the Franche Comté, his native province. The eyes are so accustomed to the microscope as to have lost in great measure their normal capacity of visional adaptation, and are devoid of expression." Pasteur admits, in his report on hydrophobia, that the microbe causing it has not been discovered, though he is sure of its existence; and that it may become again rebellious after it has been transmitted to an organism more favorable to its growth. Thus the virus inoculated from an ass to a rabbit will not kill the latter, but if passed on to another rabbit, and then to dog or man, will be fatal. He observed that in some animals the virus lost, and in others gained, force. In the rabbit its power was most visible, whereas the ape was less terribly affected. It therefore occurred to Pasteur, that, if virus were transmitted from one ape to another, it would grow weaker at each inoculation. He took some from a dog's brain, and inoculated an ape, which died from its rabid virus. He inoculated a second, and then a third, which was hardly indisposed. The virus so modified was transmitted to a rabbit, in whose body it recovered some strength. It increased in morbid power in a second and third rabbit, and attained the maximum in the fourth. It would thus be seen that virulence was only kept in check by withholding from it good conditions for growth. It would be also seen that it never recovered, when well tamed, its pristine deadliness in a single bound. Pasteur claimed to so completely tame the virus, that a dog would, in being rendered refractory to rabies by hypodermic inoculation or trepanning, show no sign of illness. In the second part of his report, Pasteur explained how the maximum of virulence was certainly attained, by making several guinea-pigs the mediums between rabbits and dogs. He told the academy he had discovered a process by which he can operate with diseased blood on healthy blood, and claims to be able to check the progress of rabies in freshly-bitten dogs or other animals. He asks the academy and the minister of public instruction to appoint a committee to study his proof experiments.

— One of the attractions of the London exhibition of hygiene is a street of old London, containing houses of various periods previous to the great fire of 1666, with the domestic arrangements of their time. Modern villa residences, as they ought to be, and as they ought not, also add to the interest of both tenant and landlord in what promises to be as great an attraction as the 'fisheries' was last year.

A correspondent of the New-York *Evening post* writes that the street representing old London was originally intended to be a life-like and life-sized model of Old Chepe, but it was found that no actual record of the locality remained. It was therefore decided to construct a street of celebrated and well-known relics, most of which have only disappeared within the last century. The work has been carried out under the superintendence of Mr. George Birch of the London and Middlesex archeological society. All the buildings belong to a period anterior to the great fire. One enters by Bishopsgate through a specimen of the old London wall: the arch is surmounted with the city arms, and a statue of Bishop William, the Norman. In the street we find the Rose inn, Fenchurch Street; the Cock tavern, Leadenhall; the Three squirrels, Fleet Street; Izaak Walton house, No. 120 Chancery Lane; and old shops from St. Ethelburga's Bishopsgate. The street is narrow, and the gables almost meet over one's head. A residence of the wealthy of that period is that of the Duc de Sully, also a house where Oliver Cromwell lodged in Westminster. There are examples of guild-halls, such as the Hall of the brotherhood, from Little Britain. Next we come upon the Old fountain hostelry from the Minories, — a quaint, tumble-down edifice of four stories, each projecting further over the other, and a lean-to gable roof. Whittington's palace is a fine specimen of the period. A full description of the show by the designers appears in the catalogue. There are specimens of all the Elizabethan types, as also of old Roman decoration in plaster and terra-cotta. The houses are peopled by figures dressed in the period from missals, old decorations, drawings, etc. Old armor, etc., has been lent, and the whole worked up into a most life-like show. The object is to give an idea of the hygienic condition under which our ancestors lived.

— The New-York *Evening post* states that the Spanish papers are full of the proposal to cut a canal from the Bay of Biscay to the Mediterranean Sea. The plan proposed is to deepen the River Gironde for some distance, and reach the open sea at Narbonne, in the department of Aude. The proposed work will be about two hundred and fifty miles long, and will save a distance of nearly two thousand miles between Suez and London. Speaking of two great engineering proposals, one paper says that the channel tunnel will turn an island into a peninsula, while the new canal will turn a peninsula into an island.

SCIENCE.

FRIDAY, JUNE 20, 1884.

COMMENT AND CRITICISM.

COMMENTS and criticisms, at this season, turn naturally toward the schools and colleges which are holding their annual assemblies, and bestowing their academic honors. A year ago, at Harvard, a vigorous speaker applied the match to materials which proved to be very explosive; and since then we have had a succession of arguments, public and private, with appeals to the law and to the testimony, European and American, respecting the value of different branches of knowledge, and the proper order of studies. Having read the various pamphlets and magazine articles which have appeared on this subject by Adams, Hofmann, White, Dyer, James, Fisher, Sumner, and Eliot, and many others; having watched the controversy, carried on in the newspapers, — it seems to us that the discussion, though rather monotonous to those who have previously thought it out, has been timely, vigorous, and useful. Probably the leaders of the battle have not in the least changed their opinions; but we think that the educated public has a clearer notion of the meaning of a liberal education, and that sounder views upon the relations of literature and science are likely to prevail, as a result of this discussion.

As to ancient life and letters, it is obvious that more and more is to be done in this country for their study. Classical teachers, conscious of the deficiencies of former days, are endeavoring to secure more enthusiasm and higher scholarship by the use of better text-books, better methods of instruction, and ampler means of illustration; and, with great advantage both to teachers and pupils, they are eliminating from the classical classrooms, by various regulations, those who can not, or will not, or do not, learn their Greek and Latin. The country will certainly gain by this.

But the Greek question, as it is called, is only one phase of the movement: there is an increasing zest in the study of antiquity, — in whatever interprets the history of mankind. The work of Baird, Powell, Mallory, Brinton, Bandelier, and of many others, is illuminating the records of the savage life and of the early civilizations in this country. The establishment of an Archeological institute of America, and the opening of an American school of classical studies in Athens, are indications of activity in the field of classical inquiry. The lectures given in various cities last winter — by Clarke on his exploration of Assos, by Waldstein on Greek archeology, and by Stillman on his studies in the Levant — are similar signs. Before many months have passed, a distinguished archeologist from Rome, the explorer of the Forum, will be lecturing among us. Collections of casts and photographs and coins are now to be found near all our classical colleges. The *American journal of philology* has reached its sixth volume, with marks of increasing value, and without drawing off material from the American oriental and the American philological societies. Even Assyrian antiquities are receiving the most serious attention in this country from men trained in Germany, and acknowledged to be most competent for the interpretation of cuneiform inscriptions. All these facts are indications to our minds that the study of antiquity is in no danger at present of being undervalued by Americans. Certainly the lovers of Greek culture need not be alarmed; for the flower of ancient literature and art will surely not be slighted by an intelligent community, once fully awakened to the study of the remote past.

On the other hand, the claims of science are receiving more and more recognition. The great laboratories begun or completed within the year at Cambridge, New Haven, Baltimore, and Ithaca, are signs, which everybody can

understand, that the physical and natural sciences are more than ever to be encouraged. Original researches are in progress in private and in public laboratories to an extent unknown among us a few years ago. More ample means of publication, especially in subjects which require costly illustration, are loudly called for. Three or four such memoirs proceeding from American laboratories have been offered to the Royal society in London, and have been ordered to be printed in their Proceedings, because there was no place for them here. The national government, with a parsimonious hand, but still with increasing wisdom, is providing for such scientific publications as are more or less pertinent to the public service. Schools of technology are increasing in number and in power. It is more and more openly asserted, that no one in these days is receiving a truly liberal education, unless he adds to mathematics and languages an acquaintance with at least one branch of scientific inquiry, derived in part from work in a laboratory, and from personal observation of the methods of research. Seaside laboratories at Newport, Wood's Holl, Annisquam, and Beaufort, are giving facilities for the study of life at the seashore, as years ago opportunities were given in the interior to the student and collector of fossils.

As we look at the situation, and recall such facts as we have stated, we believe that in American education the claims of literature and science are fairly adjusted. More ought to be done in both directions. The richest of our colleges are poor. Were the income of Harvard to be doubled, every dollar could be well employed at once. Were there to be a dozen Harvards and Yales, with plans as wise as those which have governed these old foundations, and with means as ample, the country would reap thebenefits.

IF the excellent recommendations made by the National academy of sciences five or six years ago had then been fully adopted by congress, we should probably have been spared the present suggestion to a congressional committee, that the work of the coast-survey should be divided; the hydrography and coast triangulation to be assigned to the hydrographic office of the navy department, and the geodetic work to the geological survey of the interior department. It was by the advice of the academy that the present geological survey arose, practically by the consolidation of three previously existing organizations. And in its memorandum, drawn up with great care and skill, the academy recommended that the coast-survey should be transferred to the interior department, "retaining its original field of operations, and assuming also the entire mensuration of the public domain; and that, so modified and extended, it hereafter be known as the U. S. coast and interior survey."

The purpose of the academy was plain, — to bring together, under one department, the coast (and interior) survey, for the mensuration and mapping of the country; the geological survey, for the study of its geological structure and natural resources; and the land-office, for the disposition and sale of public lands. The two latter would require their own maps, based upon geodetic points furnished by the first; and the land-office could obtain from the geological survey all the information it required as to the value and classification of lands. The entire survey of the public domain would thus fall, as is proper, under one department; and that co-ordination of work and mutual co-operation imperatively required would be obtainable without difficulty, and with the least waste.

In no event should the work of the coast-survey be divided: it forms an harmonious and congruous whole. Hydrography must be based on geodetic work. Submarine topography is important to an understanding of the structure of a continent. Nor is a geological survey deeply concerned in the niceties of refined geodetic measurements, nor in geodetic questions as such. For its purposes, work of a more rapid and superficial kind suffices; and it were much to be feared, that, in its subordination to

the geological survey, the excellence of the work of our coast-survey, now justly the highest pride of our nation's science, would deteriorate. As it stands, it may fearlessly challenge comparison with similar work by any European nation in precision, elegance, and economy. Its work is for all time.

A RECORD of the opening and closing of navigation at York Factory, Hudson's Bay, extending from 1828 to 1880, has been communicated by W. Woods of the Hudson's-Bay company. The latest date of open water in spring is June 1; the earliest closing of navigation, Nov. 3. The earliest opening was May 4; the latest closing, Dec. 9. The season, then, extends over from five to seven months, with an average of six months open water. The time when navigation would be available is limited, however, by the time of open water in Hudson's Straits, by which the bay is reached. This comprises only July, August, and September, and possibly part of October; but exact advices are not yet attainable. The question of the navigability of the Hudson's-Bay route to Europe is of vast importance for the settlers of Manitoba and the Saskatchewan; since, if it be available, they can, by a comparatively short railway-transit, reach tidewater with their crops, which otherwise cannot possibly compete with those of the north-western United States. It is understood that a trial is to be made of the route, and that a reconnoissance of Hudson's Bay, of which there are no good charts, will shortly be attempted.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The deep-sea fish, Malacosteus.

IN reading the translation of Mr. Filhol's article on the deep-sea fishes collected by the Talisman (*Science*, May 23), I have been somewhat surprised by recognizing, in A. Tissandier's figure of Malacosteus niger, an old acquaintance, the source of which may be observed in *Bost. journ. nat. hist.*, vi. plate v.

While upon this subject of Malacosteus, it may be interesting to note, that, in several specimens of M. niger now in the National museum, the slender band connecting the tongue with the mandibular symphysis, which has long been regarded as a tangled hyoid barbel, is really not free at either end, and may be only a muscle concerned in the movement of the lower jaw. I have not yet been able to find a true hyoid barbel. The pectoral contains three rays instead of five, as counted by Dr. Ayres; and the caudal is forked, and not convex.

TARLETON H. BEAN,
Curator department of fishes.

U. S. national museum, May 28.

[By an oversight on our part, we neglected to state that the illustrations of the two articles in No. 68 on deep-sea fishes were copied in part from *La Nature*, and in part from *Science et nature*. Those on p. 621 came from the latter journal, the others from the former, but not all of them in connection with the article translated. — ED.]

A bad habit of the fox-squirrel (Sciurus niger, var. ludovicianus).

Madison people pride themselves not a little on the number and tameness of their fox-squirrels, which are found by scores in the shade-trees of the capitol park and the residence streets of the city. Protected by a special ordinance, they have multiplied rapidly, and scarcely know what fear is, running along before one, on the sidewalk or fence, and occasionally even stopping, and allowing themselves to be touched, in the hope of getting a nut. We consider them decidedly more ornamental and worthy of good treatment than the ubiquitous blue-jay or sparrow, and never tire of watching their pretty ways. But to-day I noticed several engaged in far less commendable business than hiding, or opening acorns.

While passing under a row of elms, my attention was attracted by a number of short twigs lying on the sidewalk. About a hundred were counted under the first tree. They were of nearly uniform size, six or eight inches long, including the young growth of the season and a short piece of last year's wood, with one or two bunches of the nearly ripe fruit.

After a gale in the early fall, the ground under the white elms is sometimes covered with leafy branches of about the same size, which separate by a joint at the site of a former winter bud, like the so-called brittle branches of poplars and willows, which they also resemble in being a sort of natural cuttings, serving in part for propagation.[1] In the present instance, however, the ends of the twigs did not show the smooth surface of those which fall naturally; and, as there was no indication of the work of a pruner, I turned my attention to the top of the tree, where it was directed by a twig falling just as I looked up. Following its course, I saw a squirrel, comfortably seated on one of the upper branches, busily at work on the fruit of a second twig, which was soon dropped for another. No less than five were broken off in a single minute; and, while I watched, the falling twigs averaged one a minute. They were dexterously snapped off just below the fruit-cluster, a bite or two often helping in the operation. The seed was removed from each of the small samaras by a single adroit cut on one side; and, long before the rifled branch had reached the ground, another was undergoing the same fate. The dinner of this one squir-

[1] Frank devotes a few pages of his Krankheiten der pflanzen (pp. 34, 35) to this spontaneous pruning, which he considers a means of removing weakly twigs, after their vegetative period is ended. Its occurrence is mentioned as especially noticeable in Taxodium, Quercus, Populus, and Salix, but not by any means confined to these genera.

rel resulted in the pruning of over two hundred branches. A great many other trees showed equal evidence of the relish of squirrels for the seed, which they all obtained in the same wasteful manner; but this destruction can last only a short time, as the fruit falls very promptly when ripe.

WM. TRELEASE.

Madison, Wis., May 24.

The claims of political science.

Is there any valid reason why political science should not take its natural place among the sciences? That it has no such place is evident from the fact that it is almost wholly excluded from all the scientific journals that profess to be devoted to all the sciences. How many articles on political science have ever appeared in the *American journal of science*, in *Nature*, in *Science?* Can any other science be named of which the same can be said? It seems to be assumed that all that is ever said about national affairs must necessarily be of a partisan character, and be said, not for the sake of truth, but to serve some political party or private interest. Yet any one who has any faith in humanity must admit that a large amount of disinterested political work is being done. Those who deny this for the present will generally admit it for the past, and the present is always becoming the past. But, even if this were not the case, it would still be true that scientific politics is theoretically possible.

Most sciences are more or less practical; i.e., they furnish the principles which underlie the useful arts. From pure science to pure art there are always three somewhat distinct steps. The first is the *discovery* of scientific principles; the second is the *invention* of the methods of applying these principles; and the third is the actual *application* of the principles. The first two or the last two of these steps may sometimes be so intimately blended as to render it difficult to detect the line of demarcation between them; but theoretically the three steps are always present.

If, therefore, there is a political science, this must also be true of it. We will assume that there is such a science; that the operations of a state constitute a department of natural phenomena, which, like other natural phenomena, take place according to uniform laws. The pure science, then, consists in the discovery of these laws. The intermediate, or inventive, stage embraces the devising of methods for controlling the phenomena so as to cause them to follow advantageous channels, just as water, wind, and electricity are controlled. The third stage is simply the carrying-out of the methods thus devised.

Political science is one of the cases in which, in its present state at least, the first and second steps are very much blended. They are both embraced in legislation, which includes both discovery and invention. Yet the pure investigator is not entirely wanting; and the *ideal politician* or statesman would correctly represent the first stage, or pure political science. The executive branch of government fairly coincides with the third, or pure art, stage. The judiciary is properly legislative or inventive; but, in fact, it often performs executive or technologic functions.

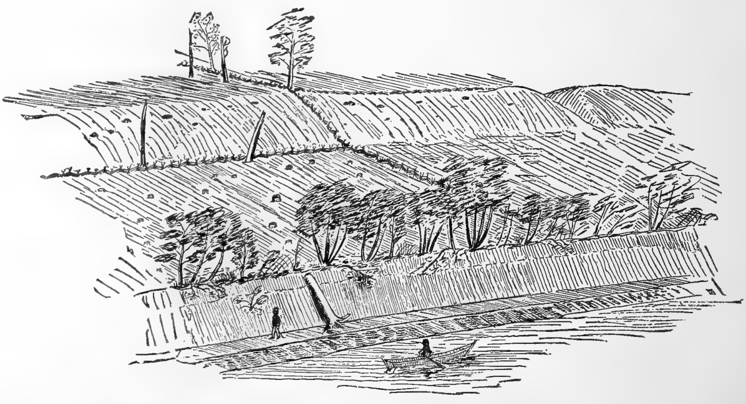
Why, then, does not politics form a legitimate subject of scientific investigation? Why might not its discussion in strictly scientific societies and journals be permitted and encouraged? And would not this be one of the best checks that could be set to the mad surge of unreasoning partisanship that now fills the columns of the public press?

It will probably be replied, that, the moment a scientific man should attempt to discuss current political issues, he would lose his scientific attitude and spirit. Were he to do so, he would certainly forfeit the respect and confidence of scientific men; but this would be contrary to our hypothesis that the discussion be scientific.

LESTER F. WARD.

Some Indiana glaciology.

In *Science*, No. 22, I gave some account of certain glacial scratches in Montgomery county which showed a trend approximately at right angles to the direction of the first, or at least a former glacier. Since that date I have made a more thorough study of the region with much better instruments, and the results are worth recording. In the short note referred to, it is stated that Sugar Creek, a large eastern tributary of the Wabash, has a general south-westerly course through the county, about parallel with that of the Wabash, twenty or thirty miles to the north. In the bed of this stream there are glacial scratches, indicating a movement parallel with its course, referred to the first or Lake Erie glacier, whose course across the state, up the Maumee and down the Wabash, has been plainly shown. In the north-eastern part of the county, near the junction of Sugar and Lye creeks, the former stream runs along a ledge of subcarboniferous sandstone, which forms its northern bank. This



ledge is from three to five feet above average water-level, has no representation on the southern bank, and is exposed for perhaps a mile. Upon uncovering its surface, it is found to be planed as smooth as a floor, and deeply and closely grooved with glacial scratches, which trend directly across the stream and the course of the old glacier. The sandstone is, for the most part, fine-grained; but in some places it contains numerous small geodes, which beautifully indicate the direction of flow, each having a struck side to the north, and a protected sandstone ridge to the south. On top of the platform there lies a typical moraine, whose trend, being about at right angles to the scratches, indicates a terminal moraine. A section showed the following results: stiff blue clay, with

scratched pebbles and small bowlders, six to eleven feet; fine sand and gravel to the top of a terrace, five feet; height of moraine above terrace, forty feet. The terrace platform spoken of is about eight hundred feet wide. (The accompanying sketch indicates these features, as seen from the creek.) At three stations along the ledge, a large area of the platform was uncovered for the purpose of measuring the angle of direction over as long lines of striation as possible. Repeated observations, corrected for magnetic variation, gave the following result: at the eastern station the direction of the scratches was N. 27° 50′ W.; a little over half a mile west, they were N. 23° 50′ W.; about an eighth of a mile farther west, N. 22° 30′ W. These differences were very unexpected, and hence great care was taken to obtain them accurately. Such angles would indicate a focal point only a few miles to the north-west. In looking over the topography of northern Indiana, it is a remarkable fact, that a ridge of limestone extends across the state, running with the Wabash valley in its eastern section, but striking more westerly in the western part of the state, leaving the Wabash to the south. North of this east and west ridge is a region of marshes and deep sand-deposits, extending to the northern boundary: south of it are more drift-deposits, but not so deep. It seems very probable that a former extension of Lake Michigan found its southern boundary in the neighborhood of this ridge. As the converging lines of our glacial platform seemed to find their centre in the neighborhood of this ridge, it seemed to suggest some relation between them. The first overwhelming flow was parallel with the ridge, and so we find the lower scratches in the Wabash and in Sugar Creek. But afterwards, in the retreat of the great glacier, there seem to have been some local centres along this ridge, which sent out small fan-shaped glaciers with rapidly diverging lines. No other explanation seems to satisfy the angles obtained in this case. Virtually nothing has been done in this state in the way of collecting the facts of the drift; and there is every indication that our relation to the Great Lakes and the peninsula of Michigan, besides the internal features already indicated, present some very interesting and important problems. The legislature of a great educational state cannot yet be induced to appropriate a dollar for any survey which does not deal with the location and thickness of coal-seams and limestone-beds.

JOHN M. COULTER.

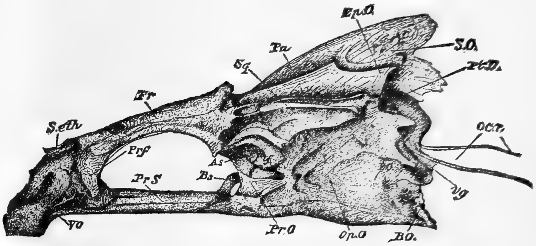
Wabash college, Crawfordsville, Ind.

Osteology of Micropterus salmoides.

I was very sorry to find from reading Mr. McMurrich's letter in *Science*, No. 69, that its author had derived nothing but the most erroneous ideas from my description of a pair of free ribs at the base of the occiput of Micropterus (*Science*, No. 65).

As Mr. McMurrich remarks, it was unfortunate that he was not able to dissect a specimen of the black bass, for the very good reason — which applies more particularly to anatomy — that one should certainly examine, in any case, structures under consideration, before publishing about them, and advancing suggestions as to what they may possibly be. Even where an author specifies that he has not seen the thing whereof he writes, people are often misled. On the other hand, I was glad to see the interest these structures awakened, and will look forward with no little pleasure to Mr. McMurrich's observations upon them, after he has had an opportunity to make a thorough examination.

As an anatomical description is made far clearer when accompanied by a drawing of the parts discussed, I determined, upon seeing Mr. McMurrich's letter, to follow that rule in the present instance, in my reply to it. To this end, I selected from my private collection a very fine cranium of Micropterus, with a pair of well-developed ribs attached to it. From this specimen I made the drawing that illustrates this letter.



Left lateral view of cranium of Micropterus salmoides, showing a pair of ribs at the occiput (from nature, half size, linear). *S eth*, supra-ethmoid; *Fr*, frontal; *Sq*, squamosal; *Pa*, palatine (not well in sight); *Ep O*, epiotic; *SO*, super-occipital; *Pt O*, pterotic; *Ocr*, occipital ribs; *vg*, foramen for vagus; *EO*, ex-occipital; *BO*, basi-occipital; *Op O*, opisthotic; *Pr O*, pro-otic; *Ptf*, post-frontal; *As*, ali-sphenoid; *B s*, basi-sphenoid; *Pr S*, para-sphenoid; *Prf*, pre-frontal; *Vo*, vomer.

From this it is very evident that these ribs are not 'portions or rudiments of the supraclaviculae,' but really have all the characteristics of the ribs upon the atlas and axis. I have never found epipleural appendages attached to them, as I believe may occur on the first two ribs of the column. Dr. Sagemehl, in his valuable paper on the cranium of Amia (*Morphologisches jahrbuch*, ix.), is very explicit in what he says about the co-ossification of the three vertebrae with the basi-occipital of this ganoid; and if this author had been aware of such a state of affairs as I here figure, in any of the Teleostei, he certainly would have brought it forward in connection with the discussion of that subject. They are two very significant facts, that these ribs in Micropterus articulate *beyond* the vagus foramen, and that they are apparently constant. I have since found similar structures in a specimen of Orcynus thynnus, and rather suspect it in the Scombridae, though the specimens at my command, illustrating this latter group, were so poorly prepared, I could not satisfy myself in regard to them. It will be of great interest and importance to examine, in this particular, forms more or less nearly related to Micropterus, and the young of all, at various stages. Of their nature, I think it may be said without doubt, that they are a pair of true ribs, agreeing in all important particulars with the abdominal ribs, as seen in the pairs on the atlas and axis; that they belong to the same series, and articulate with the occiput, to which they belong; and that they are a constant character.

I should be rather surprised to find that these structures had not been noticed before, occurring as they do in a form that has received so much attention, from an anatomical point of view, as Orcynus. Then, too, taking into consideration the morphological significance that attaches to them, one would look for at least a mention of such a condition in the text-books of Owen, Huxley, Gegenbaur, Parker, or others; but such I have failed to find, and the embryologists seem also to have overlooked them. Sir Richard Owen would certainly have had occasion to mention such a pair of ribs in his method of treating the osteology of the piscine skull.

R. W. SHUFELDT.

Washington, June 2.

JEAN-BAPTISTE-ANDRÉ DUMAS.

Jean-Baptiste-André Dumas was born at Alais, in the south of France, July 14, 1800. He was educated at the college of his native place, and appears to have been destined by his parents for the naval service; but his parents abandoned their plan, and apprenticed him to an apothecary of the town. He remained in this situation, however, but a short time. In 1816 he travelled on foot to Geneva, where he found employment in the pharmacy of Le Royer.

At that time Geneva was the centre of much scientific activity; and young Dumas had the opportunity of attending lectures on botany by de Candolle, on physics by Pictet, and on chemistry by Gaspard de la Rive.

About this time, young Dumas had the good fortune to render an important service to Dr. Coindet, to whom it had occurred that burnt sponge, then generally used as a remedy for goitre, might owe its efficacy to the presence of a small amount of iodine. Dumas not only proved the presence of iodine in the sponge, but also indicated the best method of administering what proved to be almost a specific remedy. It was in connection with this investigation that Dumas's name first appears in public, as the discovery produced a great sensation.

Soon after, Dumas formed an intimacy with Dr. J. L. Prévost, then recently returned from pursuing his studies in Edinburgh and Dublin, and was induced to undertake a series of physiological investigations, which for a time withdrew him from his strictly chemical studies. Several valuable papers on physiological subjects were published by Prévost and Dumas, which attracted the notice of Alexander von Humboldt, who, on visiting Geneva in 1822, sought out Dumas, and awakened in him a desire to seek a wider field of activity. In consequence he removed to Paris in 1823, where the reputation he had so deservedly earned at Geneva won for him a cordial reception.

In 1826 he married Mlle. Herminie Brongniart, the eldest daughter of Alexandre Brongniart, the illustrious geologist; and in after years his house became one of the chief resorts of the scientific society of Paris.

In 1828–29 Dumas united with Théodore Olivier and Eugène Péclet in founding the École centrale des arts et manufactures. In 1832 Dumas succeeded Gay-Lussac as professor at the Sorbonne; in 1835 he succeeded Thenard at the École polytechnique; and in 1839 he succeeded Deyeux at the École de médecine. Thus, before the age of forty, he filled successively, and for some time simultaneously, all the important professorships of chemistry in Paris except that of the College of France, with which he was never permanently connected.

Dumas early recognized the importance of laboratory instruction in chemistry, for which there were no facilities at Paris when he first came there, and in 1832 founded a laboratory for research at his own expense.

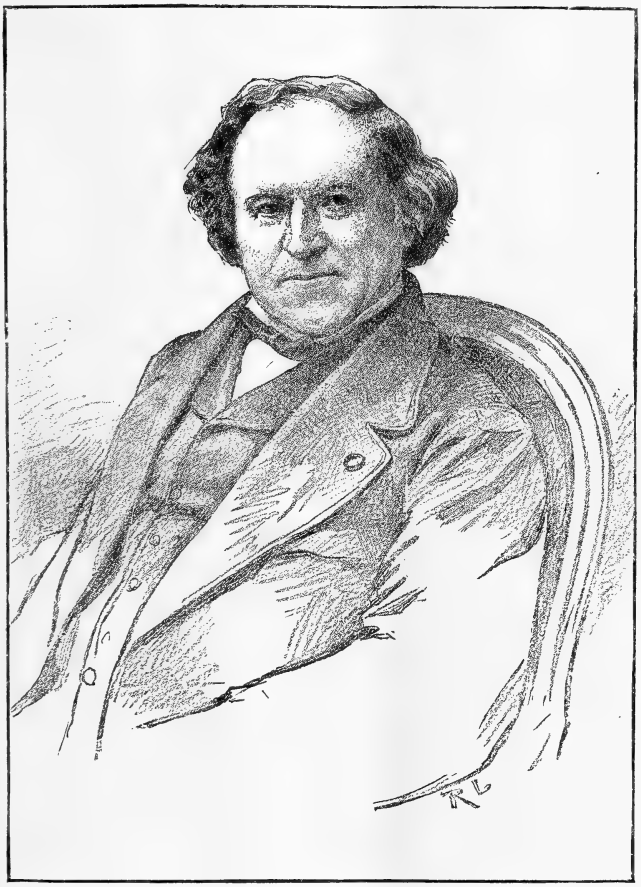
The political and social upheaval of 1848 seemed at the time to endanger the stability in France of every thing which a cultivated and learned man holds most dear; and Dumas was not one to consider his own preferences, when he felt he could aid in averting the calamities which threatened his country. Immediately after the revolution of February, he accepted a seat in the legislative assembly. Shortly afterwards the president of the republic called him to fill the office of minister of agriculture and commerce. During the second empire he was elevated to the rank of senator, and shortly after his entrance into the senate he became vice-president of the high council of education. In order to reform the abuses into which many of the higher educational institutions of Paris had fallen, he accepted a place in the municipal council of Paris, over which he subsequently presided from 1859 to 1870.

In 1868 Dumas was appointed master of the mint of France; but with the fall of the second empire, in 1870, his political career came to an abrupt termination. Some years previously he had resigned his professorships; and now, at the age of seventy, he found himself for the first time free to devote his leisure to the noble work of encouraging research, and thus promoting the advancement of science. He had reached an age when active investigation was almost an impossibility, but his commanding position gave him the opportunity of exerting a most powerful influence; and this he used with great effect. In early life he had been elected, in 1832, a member of the Academy of sciences; in 1868 he had succeeded Flourens as its permanent secretary; and in 1875 he was elected a member of the French academy as successor to Guizot, — a distinction rarely attained by a man of science. It was, however, as permanent secretary of the Academy of sciences that Dumas exerted, during the last years of his life, his greatest influence.

When the writer last saw Dumas, in the winter of 1881–82, the great chemist had still all the vivacity of youth, and it was difficult to realize his age. He took a lively interest

in all questions of chemical philosophy, which he discussed with great earnestness and warmth. There were the same fire and the same exuberance of fancy which had enchanted me in his lectures thirty years before. At an age when most men hold speculation in small esteem, I was much struck with his criticism of a contemporary, who, he said, had no imagination, although he spoke with the highest praise of his experimental skill. At that time Dumas showed no signs of impaired strength; but during the following year his health began to fail, and he died on the 11th of April, at Cannes, where he had sought a retreat from the severity of the winter climate of Paris.

Dumas was not only eminent as an investigator of nature, but even more eminent as a teacher and an administrator. Without attempting to detail Dumas's numerous contributions to chemical knowledge, we will here only refer to three important investigations, which produced a marked influence in the progress of chemical science.



After his removal to Paris he took up the problem which the relations of the molecular volumes of aeriform substances present; and his paper on some points of the atomic theory had an important influence in developing our modern chemical philosophy. We are surprised that Dumas did not at once realize the consequences which the doctrine of equal molecular volumes involves in the interpretation of the constitution of chemical compounds, and the clear distinction between 'the physically smallest particles' and 'the chemically smallest particles,' or the molecules and the atoms, as we now call the physical and the chemical units. But more than a quarter of a century passed before the full harvest of this fruitful hypothesis could be reaped.

But if this investigation of gas and vapor densities brought a great strain upon the dualistic system, the second of the three great investigations of Dumas, to which we have referred, led to its complete overthrow. The most important of the experimental results were the substitution products obtained by the action of chlorine gas on acetic acid; and the capital point made, was that chlorine could be substituted in acetic acid for a large part of the hydrogen without destroying the acid relations of the product; and the inference was, that the qualities of a compound substance depend, not simply on the nature of the elements of which it consists, but also on the manner or type according to which these elements are combined.

To the chemists of the present day these results and inferences seem so natural that it is difficult to understand the spirit with which they were received forty years ago. But it must be remembered that at that time the conceptions of chemists were wholly moulded in the dualistic system. It was thought that chemical action depended upon the antagonism between metals and metalloids, bases and acids, acid salts and basic salts, and that the qualities of the products resulted from the blending of such opposite virtues. That chlorine should unite with hydrogen was natural, for no two

substances could be more unlike; but that chlorine should supply the place of hydrogen in a chemical compound was a conception which the dualists scouted as absurd.

By the second investigation, as by the first, although Dumas gave a most fruitful conception to chemistry, he only took the first step in developing it. His conception of chemical types was very indefinite; and Laurent wrote of it a few years later, "Dumas's theory is too general; by its poetic coloring, it lends itself to false interpretations; it is a programme of which we await the realization."

The third great investigation of Dumas was his revision of the atomic weights of many of the chemical elements, and in none of his work did he show greater experimental skill. His determination of the atomic weight of oxygen by the synthesis of water, and of that of carbon by the synthesis of carbonic dioxide, are models of quantitative experimental work.

That exuberance of fancy to which we have referred made Dumas one of the most successful of teachers, and one of the most fascinating of lecturers. It was the privilege of the writer to attend the larger part of two of his courses of lectures given in Paris in the winters of 1848 and 1851, and he remembers distinctly the impression produced. Besides the well-arranged material and the carefully prepared experiment, there was an elegance and pomp of circumstance which added greatly to the effect. The large theatre of the Sorbonne was filled to overflowing long before the hour. The lecturer always entered at the exact moment, in full evening dress, and held to the end of a two-hours' lecture the unflagging attention of his audience. The manipulations were entirely left to the care of a number of assistants, who brought each experiment to a conclusion at the exact moment when the illustration was required. An elegance of diction, an appropriateness of illustration, and a beauty of exposition, which could not be excelled, were displayed throughout; and the enthusiasm of a French audience added to the animation of the scene.

To the writer, the lectures of Dumas were brought in contrast to those of Faraday. Both were perfect of their kind, but very different. Faraday's method was far more simple and natural, and he excelled Dumas in bringing home to young minds abstruse truths by the logic of well-arranged consecutive experiment. With Dumas there was no attempt to popularize science: he excelled in clearness and elegance of exposition. He exhausted the subject which he treated, and was able to throw a glow of interest around details which by most teachers would have been made dry and profitless.

In the early part of his life, Dumas was a voluminous writer, and in 1828 published the 'Traité de chimie appliquée aux arts' in eight large octavo volumes, with an atlas of plates in quarto. But, besides this extended treatise, two volumes of lectures are his only important literary works. He published numerous papers in scientific journals, which, as we have seen, produced a most marked effect on the growth of chemical science. But the number of his monographs is not large, compared with those of many of his contemporaries; and his work is to be judged by its importance and influence rather than by the extent of the field which it covers.

It was to be expected that a man working with such eminent success in so many spheres of activity, and at one of the chief centres of the world's culture, should be loaded with marks of distinction of every kind. It would be idle to enumerate the orders of knighthood or the learned societies to which he belonged; for, so far from their honoring him, he honored them in accepting their membership. It is a pleasure, however, to remember that he lived to realize his highest ambitions, and to enjoy the fruits of his well-earned renown. France has added his name in the Pantheon

'Aux grands hommes la patrie reconnaissante.'

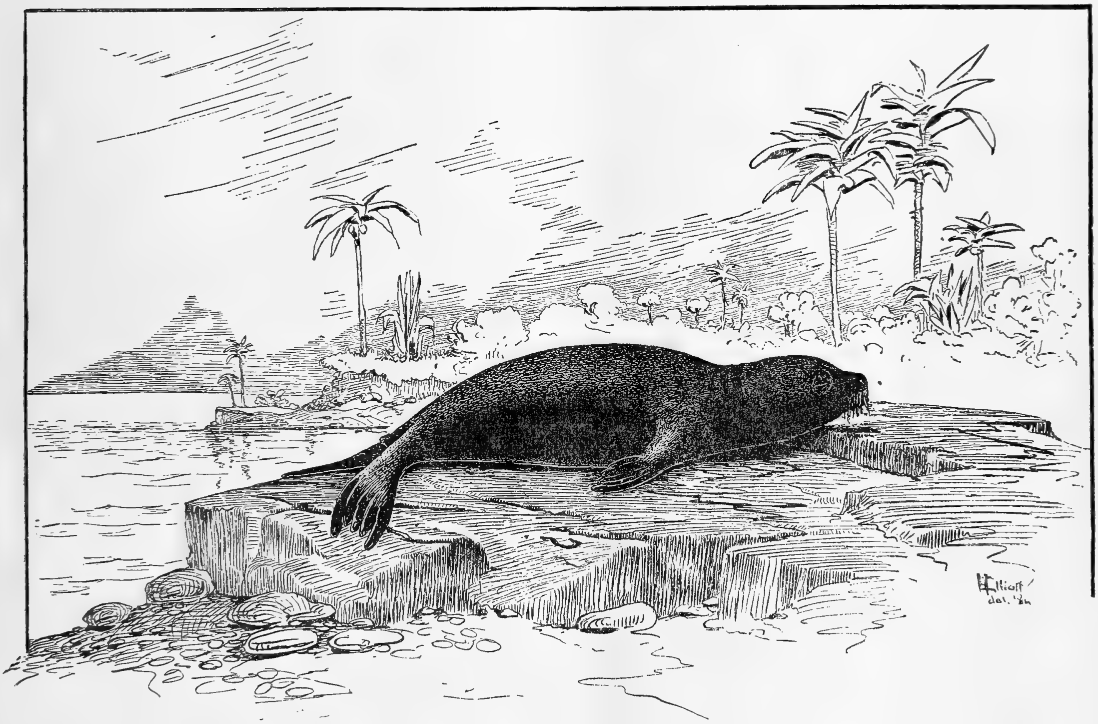
THE MONK-SEAL OF THE WEST INDIES, MONACHUS TROPICALIS GRAY.

An old English navigator and privateer, William Dampier, while straining his eyes for Spanish galleons in the Caribbean Sea during the season of 1675, was astonished at finding many seals sunning themselves on the Alacrane Islands: he was surprised, for he did not look for these animals in tropical waters, and hence he made voluminous notes of them.[1] To this memorandum we are obliged to turn for all the knowledge that we have to-day of the rare form of which we offer the accompanying drawing. The specimen from which it was taken is now believed to be the only one in existence; for the one which was in the British museum, collected in 1843 by Gosse and Hill, has been destroyed. The one which we figure is now in the new National museum at Washington: it was recently taken on the coast of Cuba, bought of some Cubans by Professor Felipé

[1] Dampier, Voyage round the world, ii. 2, 3d ed., 1705, p. 23.

Poey of Havana, and by him presented to the Smithsonian institution.

The color of the body of this tropical seal is an intense ebony black, with the hair remarkably short and stiff. The length of this creature is about four feet, with a circumference of the body near the fore-arms of three feet. Although Dampier seems to have been impressed by the large numbers of these seals in 1675, yet, as long ago as 1843, it was excessively rare, — as much so as it is to-day. This fact declares the industry and zeal of the old 'oyle' hunters, who were busy in slaughtering the Monachus long after Dampier set the example.



In the *Jamaica almanack* for 1843, Mr. Richard Hill published a memoir on a seal inhabiting the Pedro Kays, a reef of rocks lying off the south coast of Jamaica. This has been transcribed by Allen, and it seems to apply directly to the animal which we figure. Allen sums its distribution up as follows: "It therefore appears that the habitat of the West-Indian seal extends from the northern coast of Yucatan, northward to the southern point of Florida, eastward to the Bahamas and Jamaica, and southward along the Central-American coast to about latitude 12°. Although known to have been once abundant at some of these localities, it appears to have now well-nigh reached extinction, and is doubtless to be found at only a few of the least frequented inlets in various portions of the area above indicated." Being still well known to many of the wreckers and turtle-hunters, it seems strange that it should have remained almost unknown to naturalists.

Perhaps this figure and notice may serve to stimulate the attention of some one of the many fruit and sponge vessel owners now cruising in West-Indian waters, who, detecting the presence of another specimen, may secure it, and forward the rare and valuable trophy to those who would appreciate and preserve it.

HENRY W. ELLIOTT.

Smithsonian institution, May 21.

THE TOEPLER-HOLTZ MACHINE.

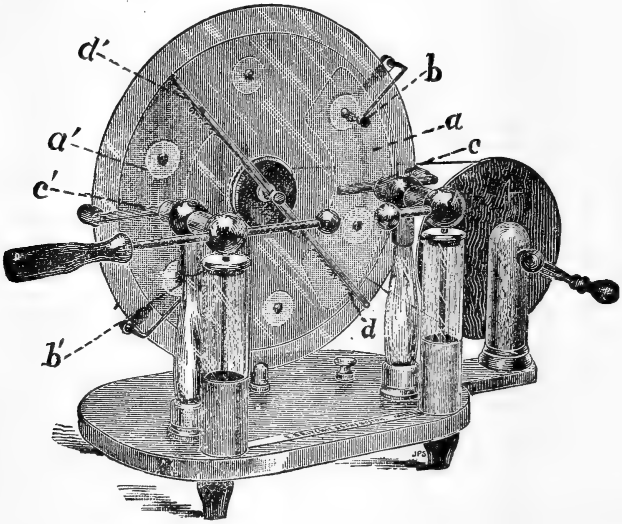
THE Toepler-Holtz induction electric machine is too well known to need description; but, as no explanation of its action is to be found in any book which has come under my observation, the following explanation may be of interest to teachers: —

Consider the machine before you, the revolving-plate in front.

Designate the right-hand paper sector by a, the brush connected with it by b, the comb connected with the discharging-rod by c, the comb in metallic connection with a similar comb diagonally opposite by d, and the corresponding parts on the left-hand side by a', b', c', and d'.

If the left-hand sector a' be charged with negative electricity, it draws positive electricity from the comb d' upon the revolving-plate, which is supposed to move in the direction of the hands of a watch. When the positive electricity on the plate reaches the brush b, it draws negative electricity from the brush, and leaves the sector a charged with positive.

This positive electricity on the sector, and the positive that is left on the plate, both draw



negative from the comb c, and leave the discharging-rod connected with it charged with positive electricity.

The plate, now nearly neutral, passes under the diagonal comb d, and from it receives a charge of negative electricity, drawn out by the positive on the sector a, which at the same time repels positive electricity along the diagonal, and out of d' upon the revolving-plate.

The plate, now charged with negative electricity, passes under the brush b', draws positive electricity from it, and thus increases the negative charge on the sector a'. The residue of negative electricity on the plate, and the negative on the sector, both draw positive from the comb c', and leave the discharging-rod connected with it charged with negative electricity. The plate, now nearly neutral, passes to our starting-point d', and the process is repeated.

If the machine is operated in the dark, the brush b', and the points on c' and d', will be tipped with the well-known positive brushes, while b, c, and d will show only the negative glowing points. The relative lengths of the brushes on c' and d' will depend on the position of the discharging-rods. If a is negative in the place of a', the position of the brushes will, of course, be reversed. The nature of the electricity on any part of the machine may be tested by bringing the point of a lead-pencil near it, and noticing the form of the discharge from the point.

The great use of the knobs on the revolving-plate is to keep the paper sectors charged. Two knobs give better results than the usual six or eight; the reason apparently being, that the larger number of knobs keeps the sectors overcharged, and there is a continual loss (by brushes from the sectors) of electricity that would otherwise remain on the revolving-plate, and help to increase the charge on the discharging-rods.

Somewhat longer sparks are also obtained by connecting the sectors and discharging-rods on the same side by conductors; but the machine, thus arranged, reverses more readily, does not give sparks so rapidly when the discharging-knobs are near together, and is started by separating the knobs.

In some forms of the machine used in Germany the fixed plate is in two parts, separated by a vertical air-space. This is an improvement, because it prevents the electricities of the two sectors from uniting across the surface of the plate. Machines of this sort sometimes have as many as sixty revolving-plates, all on one axis. Such machines give large quantities of electricity, but not very long sparks.

The following experiments, not generally known, illustrate the power of the single plate machine. If a strip of vulcanite about two inches wide is moved to and fro in front of the positive pole, the length of the spark will be greatly increased, sometimes reaching five inches and a half on a machine whose revolving-plate is only ten inches and a half in diameter. If a drop of stearine is placed on a thin sheet of glass, which is too large for the spark to pass around the edges, and the glass is held between the discharging-knobs of a good ten-and-a-half-inch machine, with the drop toward the positive knob, the spark will

pierce the glass when the knobs are about one inch apart. H. W. EATON.

GEOLOGY AND MINERALOGY OF NORTHERN CANADA.[1]

BY northern Canada, the author meant the whole of the Dominion northward of the organized provinces and districts, as far as known. His information was derived from his own observations around Hudson's Bay and in the North-west territories, and from the reports and maps of the scientific men who had accompanied the various arctic expeditions by land and sea. Specimens and interesting notes on the geology of Great Slave Lake had been received from Capt. H. P. Dawson, R.A., who had spent last year there, in charge of the Canadian station of the circumpolar commission. The distribution of the various formations, from the oldest to the newest, was illustrated by a large, geologically colored map of the whole Dominion. Referring to the Laurentian system, Professor Bell showed that it forms the surface-rock over an enormous circular area on the main continent, and that the central part of it is occupied by Hudson's Bay, with a border of paleozoic rocks around it. Laurentian rocks are largely developed in Greenland, and along the Atlantic coast from Newfoundland to Georgia. Taken together, the general outline of the Laurentian areas of North America has a form corresponding with that of the whole continent, which has been built around these ancient rocks. The Huronian strata which constitute the principal metalliferous series in Canada were closely associated with the Laurentian, and appeared to be always conformable with them. The largest and best-known areas were between Lake Huron and James's Bay; but Dr. Bell had found four belts of them on the east coast of Hudson's Bay, and others had been recognized in the primitive region to the west of it. Indeed, wherever the older crystalline rocks had been explored in Canada, belts or basins having the character of the Huronian series had been met with. Limestones, slates, and quartzites, interstratified with amygdaloids, basalts, etc., corresponding with the Nipigon formation of Lakes Superior and Nipigon, were largely developed on the Eastmain coast and adjacent islands of Hudson's Bay, and apparently, also, on the Coppermine River, and to the westward of it. But a set of hard red siliceous conglomerates and sandstones were seen to come between the Huronian and the Nipigon series at Richmond Gulf on the Eastmain coast, which appeared to be unconformable to both. Mr. Cochrane and Dr. Bell had found similar rocks on Athabasca Lake; Capt. Dawson, on Great Slave Lake; and Sir John Richardson, to the north-east of Great Bear Lake. The conglomerates, slates, and gray argillaceous quartzites of Churchill, and the white fine-grained quartzite of Marble Island, were probably of this horizon. Silurian rocks were well known to be widely spread on some of the largest of the arctic islands, and along the most northern channels of the Polar Sea. They formed an irregular and interrupted border on the western sides of Hudson's and James's Bays. A large basin of Devonian strata containing gypsum and clay-ironstone extended south-westward from James's Bay. West of the great Laurentian area, Devonian rocks could be traced here and there, all the way from Minnesota to the mouth of the Mackenzie River. They were not, however, so widely distributed as had been supposed by the older travellers who had passed rapidly through the country in the early part of the century, when the whole subject of American geology was in its infancy. The so-called bituminous shales of Sir John Richardson and others, which are so prevalent along the Athabasca and Mackenzie Rivers, were found by Professor Bell to consist of soft cretaceous strata, which had been saturated and blackened by the petroleum rising out of the underlying Devonian rocks, which here, as in Ontario, Ohio, and Pennsylvania, are rich in this substance. The principal features and the geographical distribution of the carboniferous, liassic, cretaceous, and tertiary rocks of the northern regions were successively described. Among other points of interest in reference to the post-tertiary period, Dr. Bell mentioned that the remains of both the mastodon and the mammoth had been found on Hudson's Bay, and that elephants' tusks were reported to occur on an island in its northern part. Isolated discoveries of elephantine remains had been made in the North-west territories, and several on the Rat River, a tributary of the Yukon, near the borders of Alaska.

In referring to the economic minerals, Professor Bell said that even the coarser ones, such as granite, limestone, cement-stone, slate, flagstone, gypsum, clays, marls, ochres, sand for glass-making, etc., would yet have their value in different parts of the great region

[1] Abstract of a paper on the geology and economic minerals of Hudson's Bay and northern Canada, read to the Royal society of Canada, May 23, by Dr. ROBERT BELL.

under consideration. Soapstone, mica, plumbago, asbestos, chromic iron, phosphate of lime, salt, pyrites, etc., had been noted in different localities. Among ornamental stones known to occur, might be mentioned the rare and beautiful mineral lazulite; also malachite, jade, agate, carnelian, chrysoprase, and others. Extensive beds of lignite were found in many places in the great tract of country occupied by the cretaceous and tertiary rocks in the Athabasca-Mackenzie valley and on the coasts and islands of the Arctic Sea; also in tertiary strata at Cumberland Bay, and in Greenland on the opposite side of Davis Strait. On the Moose River were considerable beds of lignite of post-tertiary age. Anthracite of a very pure quality had been found on Long Island in Hudson's Bay. Petroleum rising from the Devonian strata was found through a long stretch of country in the Athabasca-Mackenzie valley. Great quantities of asphalt, resulting from this petroleum, occurred along these rivers and on Great Slave Lake, as well as in various places in the interior. Of the metallic ores, those of iron were very abundant. Inexhaustible quantities of rich manganiferous ironstone exist on the Manitonink Islands, near the east coast of Hudson's Bay. The bedded ore formed the surface over hundreds of square miles, and it was broken up by the frost into pieces of a convenient size for shipping. Valuable deposits of magnetic iron had been found on Athabasca and Knee Lakes, and a thick bed of fine clay-ironstone on the Mattagami River. Capt. Dawson, R.A., had found a vein of crystalline specular iron on Great Slave Lake. Copper ore had been discovered on Hudson's Bay; and the native metal was known to occur in quantities on the Coppermine River, in rocks like those with which it is associated on Lake Superior. Galena was abundant in limestone from Little Whale River to Richmond Gulf, on the Eastmain coast. Zinc, molybdenum, and manganese had also been found on this coast, and antimony in the north. Gold and silver had likewise been detected in veins on the east coast; and alluvial gold had been washed out of the gravel and sand of different streams in the mountainous region west of the lower part of the Mackenzie River. For various reasons, Dr. Bell regarded this region as a highly promising one for the precious metals. The belt of auriferous drift, which crosses the North Saskatchewan at Edmonton, and from which the gold-dust is there washed, may have been brought from this region by ancient glaciers from the valleys of the upper branches of the Liard and Peace Rivers. A number of years ago, Dr. Bell had originated the theory that this gold might have been derived from Huronian rocks to the north-eastward of Edmonton; but he now thought it quite as likely to have had its source in the direction of Cassiar.

THE SCIENTIFIC ACTIVITY OF THE RUSSIAN UNIVERSITIES DURING THE LAST TWENTY-FIVE YEARS.[1]

No endeavor has as yet been made to properly estimate the scientific activity of our universities during the last quarter of a century; and this, I believe, mainly accounts for the sweeping condemnations which make their appearance from time to time, to the effect that our universities are declining, and that the high tide of their scientific activity was long ago passed. Submitting to the judgment of the reader a first feeble attempt of this kind with respect to the development of natural science, including the principles of medicine, I wish expressly to state that the material at my command, while not embracing all accomplished by the universities in the direction of natural science, nevertheless includes every thing essential to point out and prove the most prominent features of the results attained. This, indeed, is the object of the present article. My review excludes the universities at Dorpat and Helsingfors, as they, by their whole constitution, always distinguished themselves from their purely Russian brethren: it also fails to take into account the scientific activity of those members of our academy who are not connected with any Russian university. The material for this sketch has been brought together, not by myself, but by specialists in their respective branches of knowledge, — in physics, by Professor Petrushèfsky; in chemistry, by Professor Menshùtkin; in botany, by Professors Bekètoff, Borodìn, and Gobi; in zoölogy, by Professor Bogdànoff; in geology, by Professor Inostràntseff; in anatomy and physiology, by myself.

If we are to measure the scientific activity of an institution by the degree in which its members participate in the resolution of scientific questions, — and this seems to be the only correct standard, — then the activity of the Russian universities in natural science during the thirty years from 1830 to 1860 cannot be deemed great. Indeed, the number of university professors (with Russian names) engaged in scientific work was small; and these stood almost alone, as it were, hardly exerting any considerable influence over those around them.

There were, of course, many causes for this scarcity and isolation of working-forces; but the principal one, undoubtedly, is to be sought in the general conditions of university life. These conditions logically grew out of the view then accepted as to the object of university-work in regard to the intellectual

[1] Translated and abridged from the Russian of I. SÈCHENOFF, in the *Vestnik Evropy* (European herald) for November, 1883.

life of the country, — a view which, in our time, is no longer held. Even after the middle of this century, universities were looked upon in this country, merely as places for the dissemination of knowledge, where young people were instructed in the higher branches of science. To this end the entire activity of the universities was directed: indeed, the work of the university consisted simply in the delivery of lectures by professors, who undertook to acquaint their hearers with the last results of science, while the students were merely passive recipients. The professors were not required to do real scientific work, which at the present time alone constitutes true learning: such work was left to a select few, and it seldom emerged from the seclusion of the cabinet into close contact with the audience. It is characteristic of those times that such occupations were called the crude preparatory work. I myself have heard a learned man of that epoch (since dead) seriously call himself a 'laborer,' in contradistinction to the orator-professors.

The results obtained were such as might have been anticipated with this disposition of the public mind. Instruction by lectures was the chief aim: independent scientific work, although esteemed, was not obligatory, and was considered a matter to be left to personal predilection.

There were, of course, exceptions to this rule. Thus, for instance, the faculty of natural science at the St. Petersburg university showed some signs of organic scientific life, even during this period. This, however, was a consequence of the continuous close relations between the university and the neighboring academy, where science was practically cultivated, so to speak, by legal requirement. Some of the chairs of natural science in the university were occupied by academicians; others, by persons closely connected with the academy: for this reason we here find all the indications of a true scientific life. Besides the museums and the chemical laboratory, there were introduced into the university laboratories of some sort for other branches; some practical work in botany and zoölogy was required from the students; to a chosen few the physical laboratory of the academy of science was open; and even the old chemist Solovyòff himself superintended the practical exercises of the students. Tsenkòfsky's teacher, Shikhòfsky, with the aid of a single microscope, had to instruct his pupils in making microscopic observations; but he left behind him a pupil who has won a great reputation by his microscopic investigations.

We see, then, that, during the generation preceding our own, the whole condition of university life was any thing but favorable to the development of natural science. At that time, even Germany, whence our learning has been derived, probably had not yet fully awakened to the idea, that, to properly fulfil their purpose of disseminating knowledge, universities ought to be, not only institutions where science is rhetorically expounded, but also centres for developing and advancing scientific work. The old and simple belief that teaching, as well as learning, can be made successful only through real work, did not secure a broad, practical recognition in Germany before the sixth decade of the present century, when rich laboratories for natural science came to be considered indispensable attributes of a university. It is true that laboratories of some kind did exist in western Europe in former times; but their origin was due to local causes, accidental in character: they sprang up wherever a prominent worker in science had gathered pupils around him. The laboratories of our time have a much broader significance: as indispensable attributes of every university, they change the whole system of instruction; as institutions adapted to the practical working-out of scientific problems by many individual investigators, they superseded the closet of the student, and introduced to learners the very process of the building-up of science; as schools for practical instruction, laboratories materially raise the level of education among the masses; as working-centres where science is advanced, not by individual, but by united efforts, they materially increase the scientific productivity of the country. In Germany their importance is so fully recognized, that, even in universities of the second rank, hundreds of thousands of roubles are expended on the construction of laboratories in connection with the various chairs.

Hence it will readily be perceived what an immense service was rendered Russian science by the reform of our universities in the seventh decade of our century, when laboratories were established in connection with the faculties of medicine and of natural science, and provided with the necessary means, the staff of instructors being correspondingly increased. Another beneficent measure was the greater facility afforded private persons of leaving the country to study abroad, and the increased frequency with which the government sent young people abroad for the same purpose. This last measure, though long before in vogue by the universities for preparing their professors, at that time became even more necessary; for while, between 1848 and 1856, the ordering of students abroad had entirely ceased, by the new regulations the number of instructors was enlarged. I shall hardly err if I say that about one-half of the present professors in the faculties of medicine and of natural science have come from those young men who went abroad between 1856 and 1865.

The increase in the number of workers in natural science during the period under discussion appears most clearly from the formation of societies of naturalists at the universities. In the preceding period there were but two such societies in existence in Russia, — the mineralogical society at St. Petersburg, and the Moscow society of naturalists. At present there are, at the universities, seven societies of naturalists. Besides these, we have the Russian entomological society, and the societies at Yaroslàvl, Ekaterinbùrg, Tashkènt, and Tiflìs.

General confirmation of this opinion, respecting the increase in the number of workers in natural science, is found in our periodical congresses of naturalists. After the first congress, societies of naturalists organized at the universities; and the geological, zoölogi-

cal, and botanical sections of these societies began to send parties of investigators annually (usually for the summer) to all parts of Russia. Making the best of their limited means, they allowed a maximum of four hundred or five hundred roubles a person.[1]

At the instance of the same societies, larger expeditions, subsidized by the government, were sent out into Turkestàn (Fedchènko), into Khiva (Bogdànoff), into the Aralo-Caspian territory (Bogdànoff, Barbotte, Grimm, and Alenìtsyn), to the Murmàn coast (Bogdànoff, with seven students), to the White Sea (Tsenkòfsky and Wagner), among the Altai (Nikòlsky, Sokolòff, Polènoff, and Krasnòff).

Russian names occur in the foreign literature of natural science, even during the preceding period, though they are very rare, and not often important. But about 1860, that is, when Russian students began to throng to foreign universities (chiefly German), a rapid increase is perceptible in the number of Russian names appearing as contributors to foreign journals; and this number is steadily maintained at a figure previously unheard of. Even if the productions of these first years were often of an elementary character, they are nevertheless important as presenting a striking proof of a fact hitherto unprecedented in Russia; viz., that, in the very beginning of the period under discussion, a considerable number of young Russians passed through a very thorough course of study. The importance of this fact is enhanced when we recollect that our young laboratories drew their first supply of workers from those who, during this time, studied abroad.

Everybody who has ever been at the head of a newly established laboratory, will, I think, agree that it requires years, even in the case of an experienced director, to prepare two or three students for independent research. Now, in our case, in the seventh decade of the present century, the difficulty was enhanced by the fact that the management of laboratories was still a novelty, and the students were ill prepared. It is therefore not to be wondered at, that individual scientific activity only clearly manifested itself in our laboratories long after their foundation. This scientific activity, however, now exists in almost all laboratories of our country; and it shows itself in this, — that the working-out of scientific problems is not restricted to the professors alone, who may, perhaps, be said to derive their learning from western Europe. The students of the local Russian laboratories, also, now take part in this work. In former times it was impossible, with rare exceptions, for a Russian to become an independent scientific worker without going abroad to study: at present he can receive and complete his education at home.

It may not be amiss to present, in illustration of this change, some particularly striking figures.

Between 1830 and 1860, I do not recall a single special investigation in the branches of microscopic anatomy, physiology, and experimental pathology, made by a university professor of pure Russian name. During the present period, i.e., in the course of the twenty years from 1863 to 1882 inclusive, more than six hundred and fifty investigations in these branches, by authors of pure Russian name, were published in foreign periodicals. From this number are excluded all Dorpat professors, and foreigners like Professor Gruber; also, probably, a number of Russians by birth and education, but bearing foreign names.

The most remarkable showing, however, is made by our chemists. During the fourteen years from 1869 to 1882 inclusive, the journal of the Russian physico-chemical society published six hundred and seventy investigations, not including those relating to applications of chemistry to pharmacy, technology, and medicine.

Chemistry, having from the very outset of this period engaged the attention of such eminent workers as Zìnin, Bùtleroff, Mendelèyeff, N. Bekètoff, N. N. Sokolòff, and others, enjoyed a more rapid development than all other branches of natural science. For a long time it occupied among the sciences the first place; and this place it has succeeded in retaining. Just after the first congress of naturalists was held in 1867, the chemical (now physico-chemical) society was founded, with a journal for the publication of scientific researches; and this journal became the organ of Russian chemists. The investigations are thus first published in the Russian language; but the German, London, and Paris chemical societies regularly receive an account of them through special corresponding members, and they are also reported to the Italian chemical gazette. How completely the work of Russian chemists is recognized in western Europe, will appear from the statement of an eminent English man of science: Frankland said, that in chemistry there are more independent investigations published in Russia than in England. Our chemists, however, take the lead not by quantity alone: there are branches of chemistry in which they appear among the best specialists; and yet the principal representatives of Russian chemistry are engaged in researches extending over the entire domain of chemical knowledge.

The development of physics, from the very nature of things, could not keep pace with this rapid progress, especially as there were hardly any well-trained scientific men at work in this branch at the beginning of our period. At present, physics numbers, among its independent leading workers, Petrushèfsky, Lenz, Stolètoff, Avenarius, Shvèdoff, and others.

The scientific activity of our botanists proved exceedingly fertile. At the beginning of our period, Tsenkòfsky stands out eminent indeed, but alone: in the course of twenty-five years, his intellectual offspring has become a family of seventy-five workers; and of this number we may certainly assume that three-quarters grew up in the Russian school. During the preceding period, Russian botanists were almost exclusively engaged in the study of local floras: at present, the study of botany has been specialized into the branches of anatomy, physiology, development of plants, and botanical geography. In

[1] Each of these societies has a government subsidy of twenty-five hundred roubles (about fifteen hundred dollars), apart from the contributions of the members, the physico-chemical society alone receiving no subsidy.

anatomy, eighty-seven original researches appeared during this period; in physiology, a hundred and fifty-two. The number of special investigations in botanical geography during the last twenty years amounts to twenty, while the articles relating to local floras number about a hundred.

During this period, zoölogy developed in two directions: on the one hand, investigations of faunas, increasing considerably in quantity and quality, form a continuation of the preceding period; and, on the other hand, a new phase of zoölogical research is inaugurated by workers in the field of comparative anatomy, of animal histology, and of embryology. At the head of this last movement, fortunately, we find such exceedingly talented men and energetic workers as Kovalèfsky and Mèchnikoff, who enjoy in Europe a reputation not less honorable than that of the principal representatives of our chemical school. This is the reason why the new movement not only soon extended over Russia generally, but gained a strong foothold; so that at present it has representatives in every university, and unites the body of common workers into a Russian zoölogical school.

A review of the development of mineralogy and geology in the universities during the last twenty-five years is embarrassed with two difficulties. In three of the six universities to which this article refers, the scientific workers of the previous epoch continue their activity into the present period. On the other hand, the mining-engineers, *pari passu* with the university-workers, begin to work zealously, and their common labors appear in the same publications. An over-nice discrimination of the work of the mining-engineers from the work done by the universities, will, however, be superfluous, when we reflect that the stimulation of scientific activity among the mining-engineers is primarily due to the same causes that infused new life into the universities themselves. These causes were the reforms in the mining-corps (now become a mining-institution) which were in the same direction as the new system of instruction in the natural science faculties. The increased activity among the mining-engineers, being a product of the same cause, merely fortifies by additional proof the leading idea of this article. From this point of view, the activity in mineralogy and geology will appear to have increased very considerably. Since 1869 the St. Petersburg mineralogical society has published thirteen volumes of 'Materials for the geology of Russia' (in Russian). In the St. Petersburg society of naturalists alone, there were received two hundred and ten original communications from 1868 to 1882 inclusive; and, in the 'Index to Russian literature in mathematics and pure and applied science' (in Russian), we find enumerated two hundred and seventy-four works (pamphlets and books) on mineralogy and geology for the period 1873 to 1879. In addition, it should be mentioned that our present university geologists, by practical work, have transplanted to Russian soil the problem of prehistoric man, and the application of microscopy to the investigation of mineral species.

Finally, as above mentioned, the sciences of microscopic anatomy and physiology began to be cultivated in Russia between 1860 and 1870. The first to introduce them were the Dorpat professors, the late Yakubòvich and Ovsiànnikoff. They were followed by a succession of Russian specialists who had studied abroad between 1855 and 1865. The following data will show to what extent these young sciences took root and thrived in Russia. When in Germany, between 1870 and 1880, the composition of histological and physiological text-books was undertaken by collaboration, our scientific men, being recognized as specialists, were asked to write certain parts of these works. Some of them complied with this request; as, for instance, Babùkhin and the late Ivànoff. There are even names to which the honor belongs of having established new and important methods of research: to Khronshchèfsky, for instance, is due the method of transfusion. At the present day, there is hardly a branch of these two sciences that has not been more or less successfully attacked by Russian investigators; and a large proportion of their work has been done at home.

Such is a general outline of the results obtained by our universities in natural science, thanks to the reforms introduced in the seventh decade of our century. In reality they are even greater than here represented, since the data at my disposition do not include every thing actually accomplished. Is not this ample evidence that the naturalists of our universities have commendably improved their opportunity, and honorably fulfilled the task imposed on them? Not to speak of the industrial and other material advantages always following the development of natural science in a country, the mere fact that this development exists is of great importance from an intellectual point of view, especially for novices in civilization, like ourselves.

The appearance of science always marks the culminating-point in intellectual development: it is always and everywhere the surest touchstone of the capacity of a race for the highest culture. When a race has successfully undergone this test, it at once takes its place among civilized nations. When recently we mourned Turgièneff, it was justly pointed out as one of his merits, that his work had fostered the intellectual commerce of Russians with the west. Did not our naturalists do the same?

It must, however, be confessed, that, in spite of all this, we are still novices in science, and our young plantations require assiduous care. The experience of twenty-five years has demonstrated that the conditions favorable to development are to be sought in the establishment of laboratories, and in the increase of the staff of instructors. These conditions of progress, therefore, must be extended in the future, as is done in western Europe, or they must at least be maintained.

RECENT LINGUISTIC RESEARCHES.

'TOPONOMASTICS,' or the analysis of geographic names, is a branch of linguistics, which, on account of the large material and numerous publications accu-

mulating on the subject, should be considered a science by itself. Attempts to explain certain topographic appellations are found in some of the earliest writings of antiquity. Linguists and historians of prominence have always paid peculiar attention to this field of research, for no object has been named by early man without causes. Professor Egli of Zürich, who previously composed a voluminous book in furtherance of these studies (Nomina geographica, Leipzig, 1880), has just presented us with a bibliographic history of local onomatology.[1] Egli mentions over four hundred authors who have written, either exclusively or incidentally, on this instructive branch of knowledge, and subdivides their writings into four periods. The first of these extends from the earliest centuries down to 1815; the second, from 1815 to 1840; the third, from 1840 to 1860; and the last one, from 1860 to 1870. In the researches made upon American Indian locality-names, no author is more prominent than J. H. Trumbull. In another article, Egli has discussed the co-operation of Swiss scientific men in furthering local onomatology (1884).

An inquiry into the historic tribe of the Susquehannocks and the origin of the name Susquehanna has been published by Abraham L. Guss in the *Historical register* of Harrisburg, Penn. (and also issued separately), under the title 'Early Indian history on the Susquehanna.' The Virginia map of Capt. John Smith of 1606 is added to the treatise, and is of the highest importance for the early topography of these countries. The author, after a careful examination of the passages which refer to the early settlements on Susquehanna River, takes the ground, that the tribe in question was of the Iroquois stock, but that the name of the river is Algonkin, and has to be rendered by 'brook-stream,' or 'spring-water stream.'

A publication of no little interest, since it refers to an almost unknown language, is that of the Chipewayan-Tinné legend of the serpent-woman, by Emile F. S. Petitot. It is given in the original Chipewayan, with a French translation, by the Paris periodical *Melusine* (vol. ii. no. i., 1884, col. 19–21). The same interesting number also contains all the names of the rainbow of which the author could obtain any knowledge, together with explanations and myths referring to this phenomenon of nature.

Mr. John Menaul, teacher at the Laguna Pueblo of New Mexico, which speaks a Kéra dialect, is busy printing a Laguna-English catechism on his missionary press. Mrs. A. E. W. Robertson has just published her translation of the two epistles of St. Paul to the Corinthians into Creek, or Maskoki, through the American Bible society of New York (1883). Prior to this, she had translated almost the whole New Testament, with the help of instructed natives.

Ten articles previously made public by the Americanist, Count Hyacinth de Charencey, have been gathered by him in a reprint entitled 'Mélanges de philologie et de paléographie américaines' (Paris, *Leroux*, 1883. 195 p. 8°). They all refer to Mexican and Central-American languages, or to the decipherment of the calculiform Maya characters, the signification of which is still a riddle. The more noteworthy of the purely linguistic articles are those on the Sonorian group (called by him, curiously enough, the Chichimec family); on the Chiapanec, Tzotzil, Tzendal, and Cakgi; on the phonetic laws observed in the Maya family, which is called by him Mam-Huaxtec family in this article, but afterwards Maya-Quiché. Count de Charencey is one of the most active living investigators of the Indian languages, and deserves great credit for the ingenious manner by which he is prompting his countrymen to pursue these studies. But the whole attention of Europe being now directed towards the new discoveries in Africa and in parts of Asia, it seems that the time has not come yet for a general revival of Americanistic studies in Europe.

The study of jargons, or mixed languages, is a specialty to which Professor Hugo Schuchardt, the Romanist, has been devoting himself for many years. His results are published from time to time in the Proceedings of the philosophic-historic section of the Vienna academy of sciences. Three of the latest are on the Malayo-Spanish jargon of the Philippine Islands, on the English of Melanesia, and on the Indo-Portuguese of Mangalore. Schuchardt's series is published under the heading 'Kreolische studien,' and contains a large number of native songs, and other instructive specimens of the jargons spoken of. Translations are not always added to these pieces, because the majority of linguists can do without them.

A handy manual of Chinese grammar has recently been published in German by Georg von der Gabelentz, professor of oriental languages at Leipzig university.[1] It forms an extract, in succinct form, from the grammar published by the same sinologist two years before. The book is a safe guide through the intricacies of that monosyllabic language, in the acquisition of which, contrary to other languages, the judgment of the learner is put to greater activity than the memory. Twenty pages suffice to impart the elements of Chinese writing; and a short *aperçu* of the literary history of the country is added to the volume. To the Chinese words and quotations is added throughout a transcription into Roman characters.

A short scientific sketch of the Khasia language, spoken in the drainage-basin of the Brahmaputra River, eastern India, is given by A. de la Calle in the *Revue de linguistique* of Paris (1884, pp. 24–40). This article mainly consists of classified extracts from Abel Hovelacque's study of the same language, published three years since in the same periodical. Both show that Khasia holds a middle position between the isolating and the agglutinative languages, and that the majority of its terms are restricted to one syllable only.

The same number of this review concludes a bibliography of Basque folk-lore by Julien Vinson, its

[1] J. J. Egli. Ein beitrag zur geschichte der geographischen namenlehre. Wien, *Hölzel*, 1883. 106 p. 8°. (*Zeitschrift f. wissensch. geographie*, vol. iv.)

[1] Anfangsgründe der chinesischen grammatik mit übungsstücken. Leipzig, *Weigel*, 1883. 8 + 150 p. 8°.

editor. This periodical devotes special attention to the study of the Basque dialects, traditions, and literature.

The tribes of northern and north-western Australia, of which so little is known, have been sketched by Edward Palmer in the *Journal of the anthropological institute*, 1884, pp. 276-334. His article contains statements which evidently come from an experienced traveller. Nine tribes are described as to their physical and social characteristics, cannibalism, food, cooking and hunting, weapons, manufactures, amusements, superstitions, bora-ceremonies, funerals, etc. The chapter on *gentes*, or, as Palmer calls them, class-systems, brings together a large amount of new facts; and the seven vocabularies concluding the paper extend over more than a hundred and sixty terms. A. S. GATSCHET.

MODERN RAIL-MAKING.

THE making of steel rails consists of three distinct processes: the production of cast-iron from the ore; converting the cast-iron into steel in a Bessemer converter, and casting it into ingots; and rolling out the ingots into rails. According to the most recent practice, these operations follow each other so closely as to seem almost one.

Cast-iron is obtained from iron ore by reducing the ore in a blast-furnace with coke for fuel, and limestone as a flux to facilitate the reduction. The blast-furnace consists of an approximately cylindrical iron structure about seventy-five feet high, lined with bricks of refractory material, leaving an internal diameter of about twenty feet. A similarly lined bottom is securely fastened on, but can be removed for repairs. The top is closed by a cone-shaped cover suspended inside of the top of the furnace, which is here reduced in diameter. This cone is held in place by a lever and counter-weight. Air is supplied under pressure by blowing-engines, which are simply large air-compressing pumps, through openings, or tuyères, near the bottom of the furnace. The hot gases of combustion escape through openings near the top of the furnace, and are conducted away by pipes and underground conduits, — part to heat the boilers, which supply steam to the blowing-engines; and part to 'stoves,' to heat the air-blast on its way from the engines to the furnace. These stoves consist of a number of up-and-down passages built in fire-brick. Gas from the furnace is burned in one of them until it is highly heated; then the gas is turned into a cool stove, and the air-blast forced through the hot one.

The iron ore, as received from the mines, is stored in a large yard, each kind of ore occupying a specified place. The coke is stored in a large and high shed, into which it is unloaded from cars run in on overhead railroad-tracks. Supposing the blast-furnace to be in operation, the ore, limestone, and coke are loaded in hand-carts, as required; hoisted on an elevator to the charging-floor, which is on a level with the top of the furnace; and dumped upon the cone cover before mentioned. When the requisite number of loads of each kind of material is deposited on it, the cone is lowered for an instant, and the charge slides over its edge into the furnace. The ore is reduced, forming iron, which sinks by its weight to the bottom of the furnace, and a glassy slag containing most of the impurities, which floats on the top of the iron. The molten iron is drawn off through an opening at the bottom of the furnace, and, flowing through a channel in the sand floor, runs into a cup-shaped ladle holding between five and ten tons. This ladle is mounted on a narrow-gauge car on a track which leads to the converter. This completes the first stage of the process. If the iron drawn from the blast-furnace were run into channels on a sand floor, and allowed to cool, it would be the ordinary form of cast-iron known as pig-iron.

The converter, which is the essential feature of the Bessemer process of making steel, consists of a cylindrical iron casing, on which is placed a tapering portion, connecting it to a nozzle of smaller diameter. This nozzle is inclined at an angle of about forty-five degrees to the cylindrical part. The whole casing encloses a thick lining of highly refractory material. The bottom is double, the upper part being made of material like the lining, and pierced with numerous small holes, through which the air is forced in. The converter is supported on two hollow trunnions, through which the blast is supplied, and led by pipes to the double bottom. We will suppose that the converter has been heated, and is ready for a charge. The ladle of molten iron from the blast-furnace is drawn by a locomotive on an elevated track to a point a few feet above and in line with the converter. The latter is turned on its trunnions until the iron is readily poured into it from the ladle, through the nozzle or mouth. The blast of air is turned on at a pressure increasing to twenty-five pounds per square inch, and the converter turned upright. Rapid combustion takes place, the principal impurities in the iron are first attacked and burned out, the free or uncombined carbon burns next, then the combined carbon begins to leave the iron, and shortly a nearly pure iron is left in the converter. It is now turned as before, and the blast stopped: if continued, the iron itself would be oxidized. This portion of the process usually occupies about ten minutes, although some ores do not require over six, and twenty may be necessary with others.

In the mean time, an iron rich in carbon and manganese, called spiegeleisen, has been melted in a cupola resembling the blast-furnace. A definite quantity, determined by experience and analysis, has been run into a car-ladle; and, as the converter is turned at the end of the 'blow,' this car is drawn out on the track before mentioned, and the spiegeleisen poured into the converter. This is to replace, to a certain extent, the carbon burned out during the blow; the quantity being exactly determined by the quality of steel required, according to the general principle that the more carbon added, the harder is the product. The converter is now turned down; and the molten steel, which may be as much as ten tons, is poured from the nozzle into a ladle. This ladle is mounted on a hydraulic crane which stands

in the centre of a pit about five feet deep, called the ingot-pit. Around the circumference of this pit are arranged the cast-iron ingot-moulds, and the steel is drawn off from the ladle into them. A sample from each charge is tested by bending, punching, etc., and by analysis; so that an exact record is kept of each ten tons of steel. After a short interval, the ingot-moulds are lifted off: the ingots, which are approximately four feet long and twelve inches square, are taken from the pit, and loaded on cars, to be taken to the rail-mill. Thus far the methods are almost identical for all kinds of Bessemer-steel work.

The ingots arrive in the rail-mill at a dull red-heat on the outside, while the interior is at a much higher temperature. They are therefore placed in gas reheating-furnaces until at a uniform temperature, at which they can be easily worked. Following the course of one ingot, it is taken on a truck from the reheating-furnace to the rolls between which it is to be passed, and to emerge a long, perfectly shaped rail. The rolls are of cast-iron, and are in two sets, — the roughing-rolls and finishing-rolls. The first set consists of three rolls placed in a vertical row, and turning in a strong frame at each end. The ingot, or bloom as it is now called, is passed between the lower and middle rolls near one end, and is reduced in section, and lengthened. The platform on which it now rests is raised, and the bar is sent back between the middle and top rolls. The platform is lowered again; and, as it descends, a row of iron fingers, projecting up from beneath it, turns the bar, and moves it toward the middle of the rolls. Thus it is sent, through and up, back and down, moved from one end of the rolls to the other, being thereby reduced in section and correspondingly lengthened, until it finally leaves the roughing-rolls, having the approximate shape of a very large rail. As this bar goes through the roughing-rolls for the last time, another bloom is put on, and goes through for the first time at the other end of the rolls. Without a pause, the bar is carried along on revolving-rollers in a direct line to the finishing-rolls. These are two-high and reversing; being rotated first in one direction, and then in the other. The shape of the spaces between them is such that the last passage of the bar gives it the form and size of section required in the finished rail. After being sent through these rolls the necessary number of times, the finished rail-bar passes on in a direct line, as before, until it reaches a circular saw, which is swung up against it, and the rough or scrap end sawed off. The saw is swung to one side, and the bar moved along until the cut end comes against a stop-plate, which is at a distance equal to the length of one rail from the saw; and a slight motion of the saw cuts off the length. The stop-plate is swung to one side, and the rail is carried along to a large platform formed of rails laid at right angles to its direction. The rail is seized between a curved bar and a row of iron fingers which rise from beneath the platform or 'hot-bed,' and is bent. This is necessary in order that the rail shall be approximately straight when cold, as on account of the irregular shape of its section, if straight when hot, it would bend in cooling. After being bent, the rail is slid by the curved bar to either end of the hot-bed, where it is left to cool. When cool, any curves in its length are removed under a press; the rough edges left by the saw are removed with hammer, chisel, and file; the holes for the joints are drilled at both ends simultaneously; and it is loaded on a car close at hand, ready for shipment.

Each ingot makes four rails with two scrap-ends. The rail-bar, as it leaves the finishing-rolls, is thus about one hundred and twenty-two feet long. The weight of rail is regulated by adjusting the distance between the finishing-rolls, and gauging the length of the ingot in the mould. A different form of cross-section, of course, necessitates a change of finishing-rolls. From the time the ore is melted in the blast-furnace, until the rail is left on the hot-bed to cool, the temperature of the metal does not fall below that of a red-heat.

ARTHUR T. WOODS.

THE GEOLOGICAL RELATIVES OF KRAKATOA AND ITS LATE ERUPTION.

Topographische en geologische beschrijving van een gedeelte van Sumatra's westkust. Door R. D. M. VERBEEK. Batavia, *Landsdrukkerij* (Amsterdam, *Stemler*), 1883. 20+674 p. 8°. Atlas of maps, and portfolio of plates. [Our figures, 1, 2, are from this work, with slight alteration.]

Kort verslag over de uitbarsting van Krakatau op 26, 27, en 28 Augustus. Door R. D. M. VERBEEK. Batavia, *Landsdrukkerij*, 1884.

IT happens well, that, just after the attention of the scientific world is called to the Dutch East Indies by the eruption of last August, there should be published an important work on the geology of a part of Sumatra, in which the relations and structure of the great Javanese and Sumatran chain of volcanoes are described with much thoroughness. We must congratulate Mr. Verbeek on the opportune appearance of his volume and atlas on 'Sumatra's westkust,' as well as on his prompt action in gathering material for a history of the outburst of Krakatoa, of both of which we can give but too brief a mention in this notice.

Introductory to these reports, one should read over K. Martin's review of the present knowledge of East-Indian geology,[1] which contains in an appendix a list of forty-seven publications on the subject; or the brief statements of the question by Verbeek himself that have been prepared for recent exhibitions;[2] and, in

[1] Die wichtigsten daten unserer geol. kenntniss vom niederländisch Ost-indischen Archipel. Bijdragen tot de taal-, land-, en volkenkunde van Neerlandsch-Indië, 1883.

[2] Descriptive catalogue of rocks, coal, and ores from the Dutch East-Indian Archipelago, prepared for the Melbourne international exhibition, 1880. (Batavia, Kolff.) Géologie des Indes néerlandaises, prepared for the international exhibition at Amsterdam, 1883.

the same connection, one should consult Verbeek's earlier report on southern Sumatra, which contains descriptions of Krakatoa itself before the eruption.[1]

Fig. 1 is taken from a series of generalized profiles illustrating the geological history of Sumatra. Archaean rocks are nowhere seen.

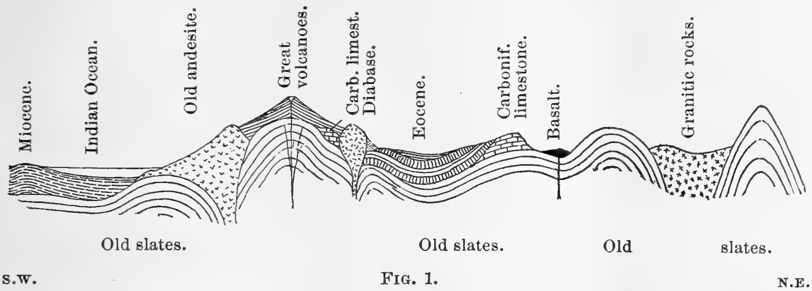


Fig. 1.

The oldest members of the series are non-fossiliferous slates and limestones, in places holding quartz veins that are sometimes auriferous, and cut by eruptives of the granitic group: these are overlaid by limestones, well proved to be of carboniferous age, cut by diabasic eruptives. Mesozoic strata are absent, implying a general elevation to a broad land-surface, followed in eocene time by depression again, during which workable coals were formed. There are other tertiary strata, such as the miocene beds of the small islands to the south-west, succeeded by broad quaternary deposits over the lowlands. The early tertiary eruptives (basalt and hornblende andesite) are relatively scarce, and are but dwarfs among the gigantic cones that have been heaped up since the end of tertiary time. These are chiefly augite andesite, mostly in the form of ashes and sand, holding larger blocks, but sometimes as dikes or lava-flows. They reach almost 3,000 metres altitude, flattening from a slope of 30° or 35° at the summit, to an almost level plain at the base, with a curve of descent that is shown to be closely logarithmic in its form. Krakatoa (here called Rakáta) is one of these cones, standing on the most south-eastern transverse group of the great range of Sumatran volcanoes, of which sixty-six are given in a list, and seven among them (not including Krakatoa) are marked active. A considerable share of attention is given to lithology; and on the atlas sheets, the different classes of eruptive rocks are distinguished. There are also special descriptions of the several craters formed successively about the great volcanic centres, — as on the summit of Merapi (fig. 2, ideal section), where four concentric walls, almost unbroken, stand one within the other, a gigantic cone-in-cone structure, — and also of the formation of volcanic lakes, from the small ones in the well-preserved craters, to the large basins of Maniendjoe (100 □ kilometres in area), the result of a central caving-in of a great volcano whose remains are seen in the surrounding Danan Gebergte, or Lake Mountains; and the still larger Singkarah (112 □ kilometres), formed by eccentric subsidence.

The theory illustrated by von Hochstetter[1] is quoted to account for the mechanism of these changes. His figures are therefore here reproduced, with slight alteration, as of additional

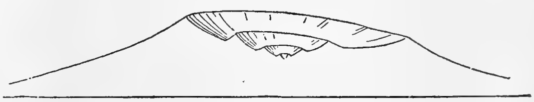


Fig. 2.

value from their acceptance by an observer practised in the study of volcanic phenomena on the largest scale. Fig. 3 shows the effect

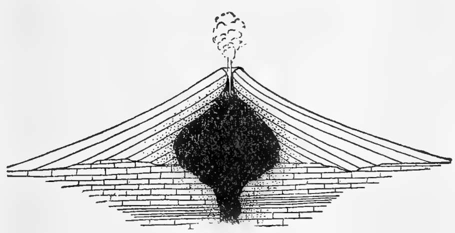


Fig. 3.

of continued eruption in melting the interior part of the cone previously formed: the volcano is here active. Fig. 4 shows the falling-

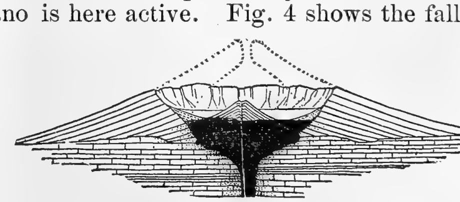


Fig. 4.

in of the cone when the molten interior is blown out, or allowed to sink, and, in this

[1] Topographische en geologische beschrijving van Zuid-Sumatra. Door R. D. M. Verbeek (215 p., with geological map, profiles, etc.); Jaarboek van het mijnwezen in nederlandsch Oost-Indië, 1°, 1881. Our figures, 5, 6, 8, are from this work.

[1] Ueber den inneren bau der vulkane. Neues jahrb., 1871, 469.

form, is applicable to the Oeloe-Danan volcano, shown in true proportions in fig. 5 (scale, 1 : 20,000), or to Maniendjoe, and

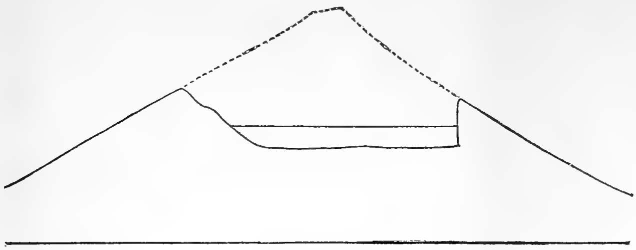


FIG. 5.

probably to Krakatoa: the volcano in this stage is dormant for a longer or shorter period. A renewal of eruptive action would build a new cone within the circular walls remaining from

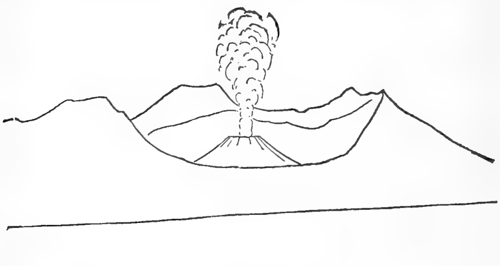


FIG. 6.

the old cone, like Vesuvius in Somma, or like the Vogelsang crater in the old Kaba cone, seen across the lower slope of the neighboring Tjoendoeng volcano in fig. 6: this has been three times repeated in Merapi, fig. 2. Finally, fig. 7 represents the molten interior, neither thrown out nor drained away, but allowed to stand and cool slowly into a solid crystalline mass, revealed in part by subsequent erosion: such a volcano is definitely extinct.

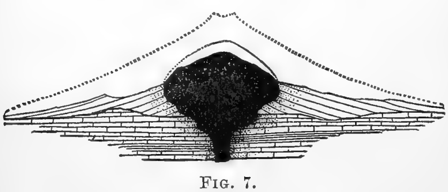


FIG. 7.

Mr. Verbeek shows himself to be one of the not very numerous geological writers who appreciate the needs of their readers. His reports open with brief abstracts of their results, from which these notes are in large part taken. On reading his abstracts, a general idea of the whole work is gained; then, by following the well-prepared table of contents, any special topic is easily discovered for closer study. The whole volume is very simply written, and well printed: it lacks only page-headings and index. The atlas sheets, on a scale of 1 :100,000, are prepared with satisfactory neatness; but their topography is not so expressive as one might wish, nor are the profiles near enough a natural scale: but, apart from this, the work is most creditable to the Dutch colonial department.

The preliminary report on the eruption of Krakatoa gives a brief account of the results of the author's seventeen-days' trip in the region of the disaster, combined with general records of other observers. It is dated Buitenzorg, Feb. 19, 1884. The knowledge of the island before the eruption is based on the English and Dutch surveys, whose outline-maps have of late been frequently reproduced, and on sketches by Buijsken in 1849, and the author in 1880 (fig. 8). The northern, lowest summit threw out pumice in 1680, and, after two centuries' rest, began work again in May, 1883, continuing with irregular activity till Danan, the middle summit, joined it in the

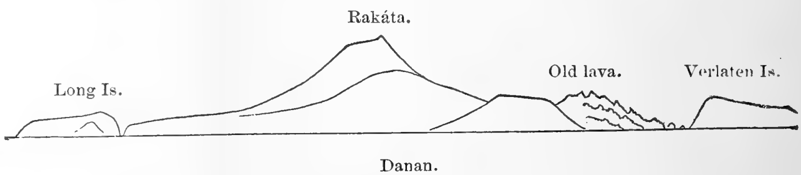


FIG. 8.—KRAKATOA FROM THE NORTH.

great explosions of August. The original area was 33½ □ kilometres, of which 23 sank; leaving water 200 to 300 metres deep, except where a single rock rises 5 metres above the sea-surface. The remaining 10 □ kilometres — the background of fig. 8 — grew to 15⅓ by addition of ashes on the south and south-west. In the same way, Long Island increased from 2.9 to 3.2; and Verlaten (Deserted) Island, from 3.7 to 11.8 □ kilometres. All these accumulations were made of ashes and dust; for, although molten lava doubtless existed in the crater, there were no overflowing lava-streams. The greater share of the erupted material fell within 15 kilometres of the island,

where it attained depths of from 20 to 40 metres; rising even to 60 or 80 metres on the flanks of Rakáta (corrupted to Krakatau), the southern and highest part (822 metres) of the island. Fragments the size of a fist were thrown 40 kilometres from the volcano. Between Krakatoa and Sebesi, to the north, the ashes and pumice filled the sea at two points, forming low islands (Steers and Calmeijer), which have already been much broken and degraded by the waves. The sixteen little craters reported near where these islands stand have had no existence: they were only smoking heaps of ashes.

The precise hours of the heaviest explosions were not determined directly, but were based on the self-registering pressure-gauge of the gasometer in Batavia, as there was no self-registering barometer there. Making seven minutes allowance for the time of air-wave passage from the volcano to the gauge, the most violent eruptive action occurred at 5.35, 6.50, 10.5 (maximum), 10.55 A.M., Aug. 27, Batavia time. It was these air-shocks that were felt by barometers all around the world. In the May eruption, sounds were heard 230 to 270 kilometres; but in August the noise of the explosions was audible 3,300 kilometres from the island, or within a circle of 30° radius, equalling one-fifteenth of the earth's surface. The sounds spread irregularly; and it is suggested that the wind and the ashes in the air had much to do with the silence at points near which the eruption was distinctly heard. The eruption of Tomboro in 1815 was heard only half this distance; but the quantity of its ejected material (calculated from a correction of Junghuhn's data) was eight to eleven fold that thrown from Krakatau, which Verbeek determines to be close to 18 cubic kilometres. Two-thirds of this fell within 15 kilometres of its origin, as will be shown on an ashes-map, to be published in the final report. The ashes contain from sixty to seventy per cent of silica. Under the microscope, they show, 1°, glass in small, porous, irregular fragments; 2°, plagioclase felspar, with inclusions of glass, apatite, augite, and magnetite; 3°, pyroxene, probably rhombic as well as monoclinal, with inclusions of glass, apatite, and magnetite; 4°, magnetite in grains and octahedrons; this is the oldest component, and decreases in quantity on receding from the island. The great ten-o'clock wave, which it is thought resulted from the falling-in of the northern part of the island, following the most violent explosion, rose to heights of 30 and 35 metres on some of the neighboring coasts, and destroyed more than thirty-five thousand people. Maps, tables, and drawings are in preparation for a more detailed report; and this, in connection with the report we may expect from the sun-set committee of the Royal society, will form a most entertaining addition to the already interesting literature of volcanoes.

STOKES'S LECTURES ON LIGHT.

Burnett lectures on light. First course, on the nature of light. By GEORGE GABRIEL STOKES. London, *Macmillan*, 1884. 9+133 p. 24°.

THIS little book consists of lectures delivered at Aberdeen in November, 1883. They have their origin in an interesting manner, which is, perhaps, possible only in Great Britain. Just a century ago John Burnett, a merchant of Aberdeen, bequeathed a fund to establish prizes for theological essays. These prizes, a first and second, were to be competed for once in forty years; and awards have been made on two occasions since the foundation. In 1881, however, a new direction to the foundation was given by order of the secretary of state for the home department, in which it was provided that a lecturer should be appointed at intervals of five years, to hold office for three years. The subjects to be treated are, 1°, history; 2°, archeology; 3°, physical science; 4°, natural science. Professor Stokes was chosen as the first lecturer.

The lectures are unique, as far as our knowledge extends, in the effort to present the higher portions of optics without the employment of experimental demonstrations, diagrams, or mathematical language.

Whether the knowledge assumed in the reader, which does not include any thing of the theory or phenomena of interference, diffraction, double refraction, or polarization, is sufficient to enable him to understand every thing contained in the lectures, is problematical. But, at any rate, to those better equipped, the book gives a most concise and interesting review of the history of optics. A personal reminiscence of a conversation with Sir David Brewster (p. 15), the last great champion of the theory of emission, just after his return from Paris, where he had witnessed Foucault's crucial experiment regarding the velocity of light in air and in water, is highly interesting; for it shows us the singular motive which prevented even so acute a mind as Brewster's from yielding to overwhelming evidence: "he was staggered by the idea, *in limine*, of filling space with some substance merely in order

that 'that little twinkling star,' as he expressed himself, should be able to send its light to us."

Noteworthy is Professor Stokes's opinion (p. 83) of the astonishing conclusions of Young and Forbes as to the varying velocities of propagation of different wave-lengths in vacuum; for his doubts as to their validity seem founded only upon the fact that the conclusions depend upon the judgment of the eye of a single observer.

We shall await with interest the publication of the next year's course, which is to be devoted to researches in which light has been used as a means of investigation. The third year's course will "be assigned to light considered in relation to its beneficial effects."

NOURSE'S AMERICAN EXPLORATION IN THE ICE-ZONES.

American exploration in the ice-zones (etc.), prepared chiefly from official sources. By Prof. J. E. NOURSE, U.S.N. Boston, *Lothrop,* 1884. 3 + 578 p., illustr., maps. 8°.

THE work of Professor Nourse does not profess to be, and is not in any sense, a study of the results of arctic exploration performed by Americans, or of the relation of American explorations to explorations made by the people of other nations. It is simply a collection of narratives of the different expeditions, — gotten up, like the stock compilations, by hack-writers, — which are published on various subjects from time to time. It is a book undeserving of high praise, either in its contents or its make-up. The only thing which redeems it from perfect mediocrity is the fact that it contains some data in relation to the North Pacific exploring expedition, under Rodgers, the report of which still remains unpublished, and a few facts from Hooper's report of his voyage in the Corwin in 1881, the original of which has not been made public.

The record is complete only for the naval and military expeditions. Those of the telegraph explorers, 1865–68, are not even mentioned, though much of their work was in really arctic regions; and the indirect results of their explorations have added one-seventh of its area to the present United States, and have contributed at least one hundred titles to geographical bibliography. The travels of Kennicott and others in the Hudson-Bay region, of Nelson in northern Alaska, the work of the coast-survey in and north of Bering Strait in 1880, are left to other chroniclers. We presume this may be accounted for by the fact that the investigations referred to, and their value, are familiar only to students, specialists, and geographers, and not easy of access to the mere compiler.

From a literary point of view, the work is open to severe criticism. The thread of the narrative is frequently broken for the most trivial digressions, which are pursued at great length. The misprints are numerous, and generally of that objectionable kind which confuses the sense, without being obvious to the ordinary reader. Trifling matters are detailed at length, while more important ones are omitted.

In spite of all this, the book will be attractive to youthful readers who are not critics, and enjoy unfamiliar details, and to whom the really weightier matters are not important. It is fully illustrated by cuts drawn from Rink, Bessels, Hall, Hayes, and various government publications, and is accompanied by the worst map of the circumpolar regions which we have ever encountered.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Paleontology. — Mr. C. D. Walcott has prepared the manuscript for a report on the St. John fauna of New Brunswick, contained in the Hartt collection. It is ready for publication as a bulletin of the survey, and only awaits the completion of the drawings illustrating it to go to press.

During April the collection of Devonian fossils from the Hamilton group of New York was transferred to the U. S. national museum, and recorded. The collection was made about Moravia, N.Y., by Mr. Cooper Curtice, during a portion of the field season of 1883. It also included a quantity of specimens collected by Mr. Curtice prior to his becoming a member of the geological survey. The collection consisted of fifteen hundred and seventy-seven specimens, containing sixty-two genera and a hundred and eighteen species.

Dr. C. A. White, during May, was occupied mainly with the examination of fossils forwarded from California by Mr. G. F. Becker, and in preparatory study for his proposed work in the mesozoic and cenozoic areas of California during the coming season. Dr. White started for California the 2d of June, and will probably take the field first in the Clear Lake region, and make a section towards the coast.

Mr. J. B. Marcou has about completed the sorting and arranging of the type specimens in the National museum, and will soon take the field. He will devote his time to the study of the mesozoic and tertiary formations along the Atlantic coast, especially in New Jersey, Maryland, and Virginia, and possibly in North Carolina, beginning in New Jersey.

Prof. L. C. Johnson has assorted and labelled all of his collections made last season, so as to show the localities from which they were obtained, and the geological horizons which they represent. He has now left for Mississippi, where he will begin to collect in the cretaceous and in the older tertiary.

Prof. William M. Fontaine is still engaged in the study, classification, and description of the fossil plants from the younger mesozoic strata, and in the preparation of drawings in illustration of his work.

Prof. H. S. Williams reports progress in his work of elaborating the material collected by him, and in writing his report upon the comparative study of the Devonian faunas of western New York.

U. S. signal-office.

The progress of tornado investigation.[1] — In the study of tornadoes it has become necessary to undertake something more than a simple record of their occurrence, or an occasional investigation of those that are attended with unusual destruction to life and property. A practical knowledge of the nature of these destructive storms is a matter of the utmost importance to the inhabitants of certain sections of the country; and not least among the objects aimed at by the chief signal-officer, in directing the continuance of tornado investigation, is to allay any needless anxiety or fear on the part of those people living in the regions most frequented by these storms. Methods of observation based on reports from stations situated from one hundred to two hundred miles apart, as in the case of cyclones and hurricanes, are inadequate to develop the mysteries of the funnel-shaped tornado-cloud.

As a consequence, therefore, a new plan was devised, based on the result of special investigations in 1882 and 1883, by means of which it is now sought to study more intimately the origin, character, frequency, and geographical distribution of tornadoes.

To inaugurate the details of the proposed system of work, it became necessary to establish a corps of observers, whose duty should be to report the occurrence of tornadoes, and make examinations of their paths and various phenomema; for which purpose special definite instructions are issued.

The observers are called tornado reporters, and now number about eight hundred. Their stations are mostly located in the states of Alabama, Georgia, South Carolina, North Carolina, Missouri, Arkansas, Kansas, Illinois, Indiana, Iowa, Nebraska, Wisconsin, and Minnesota. These are the states in which tornadoes are of most frequent occurrence: and this distribution limits our study to certain states, and even certain portions of a single state; for there are portions of some states that are frequently visited, and other portions seldom, if ever, visited by tornadoes. In the regions of greatest frequency the stations number from one to three in each county, depending upon its size.

[1] Communicated by permission of the chief signal-officer, U. S. army.

Tornado reporters, in return for their voluntary contributions, are supplied with the tornado publications of the signal-service; they are also furnished with the material necessary for the proper record and mailing of observations and reports.

Reports are forwarded to the chief signal-officer as soon as possible after the occurrence of a tornado, and consist of detailed descriptions, instrumental observations, photographs, diagrams, charts, and illustrations.

While attention is mainly given to the examination and report of tonadoes for the current year, each reporter is instructed to work up the past history of these storms in his state, making careful search after any facts relating to windfalls, or other traces of past tornadoes. Some of the results sought to be attained by the above method of investigation may be briefly given as follows: 1°, to determine the origin of tornadoes, and their relation to other atmospheric phenomena; 2°, to determine the geographical distribution of tornadoes, and their relative frequency of occurrence in different states, and in different parts of the same state; 3°, to determine the conditions of formation with a view to the prediction of tornadoes; 4°, to determine the means of protection for life and property; 5°, to determine the periodicity of the occurrence of tornadoes, and their relative frequency by seasons, months, parts of month, and time of day; 6°, to determine the prevailing characteristics of tornadoes; 7°, to determine the relation of tornado regions to areas of barometric minimum.

A review of the past year gives the following as some of the principal results: —

1°. That there is a definite portion of an area of low pressure within which the conditions for the development of tornadoes is most favorable; and this has been called the 'dangerous octant.'

2°. That there is a definite relation between the position of tornado regions and the region of high contrasts in temperature, the former lying to the south and east.

3°. That there is a similar definite relation of position of tornado regions and the region of high contrasts in dew-point; the former being, as before, to the south and east.

4°. That the position of tornado regions is to the south and east of the region of high contrasts of cool northerly and warm southerly winds, — a rule that seems to follow from the preceding, and is of use when observations of temperature and dew-point are not accessible.

5°. The relation of tornado regions to the movement of upper and lower clouds has been studied, and good results are still hoped for.

6°. The study of the relation of tornado regions to the form of barometric depressions seems to show that tornadoes are more frequent when the major axis of the barometric troughs trend north and south,

or north-east and south-west, than when they trend east and west.

7°. Tornado predictions have been made a matter of daily study since the 10th of March, 1884; and the average up to June 1 shows that it has been possible on fifty-five days to successfully predict from the morning weather-map that no tornado would occur on that day. On twenty-eight other days tornadoes were predicted for particular states or larger regions; and of them the tornadoes on seventeen days occurred in or near the specified region, while on eleven days tornadoes occurred in regions for which they were not predicted.

JNO. P. FINLEY,
Sergeant signal-corps, U. S. army.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Trenton natural-history society.

June 10. — Mr. F. A. Lucas described the building-habits of some birds. The cat-bird seems indifferent as to locality, building ten feet from the ground, or quite as often in a tangle of weeds within eighteen inches of the surface. The song-sparrow's nest is small and delicate, resting on the ground, often in a slight depression, which makes it very inconspicuous. —— Dr. C. C. Abbott remarked on crayfish; also on a catfish new to the locality, and on field-mice. He had taken the meadow-mouse (Arvicola riparia) from a dead log, where it had hollowed a nest, lining it with hay and a few feathers; also from driftwood into which it had tunnelled. The food seems to be chiefly seeds, although it is probably carnivorous at times. Under the loose bark of decaying, prostrate trees, the white-footed mouse (Hesperomys leucopus) is occasionally found, although it usually makes a home in a thicket of briers or a deserted bird's nest. The favorite food is unfledged birds. They are much afraid of snakes. They beat a hasty retreat when a dead snake is placed near the nest; but when convinced, by cautious examination, that the intruder is harmless, they bravely devour it. —— Prof. A. C. Apgar remarked on some rare plants: Vicia Americana, Muhl., never before observed in New Jersey; Viola pubescens eriocarpa, Nutt., a western variety; Polemonium reptans, L., which had been removed from the Geological survey's preliminary catalogue of New-Jersey plants, under the supposition, that, being so remote from its usual habitat, it must have been incorrectly determined; Nuphar pumilum, Smith, and Struthiopteris Germanica, Willd., the last not having been previously observed in the state. —— Dr. A. C. Stokes communicated a paper on Tarantula arenicola Scudder, detailing its method of burrowing, of building the tower above the entrance, and of capturing food. Before the pit and tower are completed, the spider will seize food at some distance from the aperture: when finished, she leaps from the tower, and runs across the ground to take the selected victim. If within the burrow when an insect passes over the tower, or becomes entangled in the loose grass of which it is usually formed, the spider rushes to the top, and the insect, if acceptable, is seized. The towers are irregularly five-sided, and an inch or less high. The burrows are cylindrical, perpendicular, and vary in depth from eight to twenty inches; in diameter, from one-quarter to three-quarters of an inch.

Entomological society, Washington.

June 5. — Mr. George Marx read a composite paper on the geographical distribution of the Arachnidae of the United States, on the respiration of Epeira insularis, and biological notes on Latrodectes verecundus. The range of each family was pointed out in succession ; and the colorational changes, dependent upon locality, were treated at some length. The speaker had noticed a true alternate opening and closing of the pulmonary stigmata of the Epeira, on taking it from a tight box in which it had been confined for some days. By a careful rearing of the Latrodectes, he had thrown together no less than ten species described by Abbott, which are now referable to the different stages of L. verecundus. —— Mr. E. A. Schwarz exhibited specimens of Ino immunda (Cucujidae) and Eleusis pallida (Staphylinidae), calling attention to the marvellous resemblance, which he stated could not be referred to mimicry for protective reasons, but must be considered accidental. —— Mr. L. O. Howard exhibited specimens of Inostemma Boscii (Proctotrupidae), and gave a short history of the theories concerning the curious thoracic appendage, arriving at the conclusion that it is a secondary sexual character. He also exhibited specimens of a new species of the genus Schizaspidia, collected in Florida by Mr. Schwarz, and which is also furnished with remarkable thoracic prolongations. —— Dr. W. S. Barnard read a short paper on the development of Gordius and Mermis, exhibiting a specimen observed to issue from Harpalus pennsylvanicus.

Brookville society of natural history, Indiana.

June 3. — Robert M. King presented a paper upon some studies of the land-shells of Indiana, showing differences in habits, food, and color of the shell. —— Aug. Diener gave a short paper upon the Luna moth, presenting the time of its appearance, and the length of periods of its several changes. —— E. R. Quick spoke at some length on the results of the trip of Alexander Wilson down the Ohio River in 1810, referring particularly to Wilson's advice concerning the opening of the Grave Creek mound, and to his labors in the neighborhood of Cincinnati, at the mouth of the Big Miami River, at what is now the town of Vevay in Switzerland county, this state, and in the neighborhood of Louisville, — all points of interest, because of their proximity to the field in which the society is working.

Biological society, Washington.

May 31. — Mr. James E. Benedict described the recent cruise of the steamer Albatross in the Gulf of Mexico and the Caribbean Sea, and exhibited some of the most remarkable objects collected. —— Ensign E. E. Hayden, U.S.N., read a paper on a new method of figuring fossil leaves and other objects by the aid of photography, with a saving of time, and increase of accuracy; the method consisting of drawing in India ink, upon a silver-print photograph, the outline of the object to be figured, the defects of the photograph being supplied by the draughtsman through comparison with the specimen. The photograph is then dismissed, and a photo-engraving is made by the ordinary method from the black lines of the sketch which remains. In the discussion which followed, it was shown that this process was novel only in its successful application by the author to the illustration of fossil leaves. —— Mr. J. A. Ryder spoke of the development of viviparous minnows, and particularly of Gambrusia patruelis B. & G. The young fish develop within the body of the female parent, and within the follicles in which the eggs themselves were developed. These follicles, which were covered with a rich network of fine capillary vessels, assumed the office of a respiratory apparatus, by which the gases were interchanged between the embryo and the parent fish. This follicle also acted as an egg-membrane, being actually perforated by a round opening, which the speaker termed the 'follicular pore,' and which was analogous to the micropyle of the ordinary fish-egg. The arrangement of the follicles of the ovary within the body of the female was described at some length, and the peculiar differences between the two sexes in the arrangement of the viscera were pointed out. The fibrous bands, which act as supports or stays to the basal portion of the anal fin of the male, which is modified as an intromittent organ, were also described. The great difference in the sizes of the sexes was also referred to, the female weighing over six times as much as the male. The speaker concluded by expressing his earnest desire to investigate the other known forms of viviparous fishes, such as the Embiotocoids of the west coast, the viviparous blenny, and other bony fishes which have this habit, and which, in his opinion, would throw considerable light upon some of the peculiar physiological processes involved in the viviparous methods of development. —— Mr. Romyn Hitchcock exhibited a collection of Foraminifera belonging to the genus Lagena, and explained the relations between this genus and the Nodosarine group; these briefly being that Lagena may be taken as the type of the group, passing through various stages of complexity, through Nodosaria, and ending in Cristellaria as the most complete manifestation of its method of growth.

Natural-history society of New Brunswick, St. John.

May 6. — Mr. R. Chalmers read a paper on the history of the Grand Falls of the St. John River, explaining its origin and features. Like Niagara Falls, it was shown to be the result of geographical changes in the quaternary era, causing the damming-up of a more ancient channel, and the consequent erosion of a new one. Facts bearing upon the nature and rate of change were at the same time given.

June 4. — Mr. C. F. Matthew gave an account of the late meeting of the Royal society of Canada, in Ottawa, reviewing the papers read in the natural-history section, and especially remarking on the importance of Dr. G. M. Dawson's discovery of evidences of an interglacial era in the north-west. —— Dr. L. Allison read a paper on the structure and habits of rhizopods, with special reference to local forms.

NOTES AND NEWS.

ONE of the best results of the polar exploration congress, held at Vienna in April, was a resolution that the observations of all the polar stations should be published not only in the language in which they were written, but in German, English, or French as well. Neumayer of Hamburg appealed to the congress for aid in his endeavors to make hydrographic charts of the South Atlantic Ocean. The chiefs of the different stations reported their observations. The scale adopted by the committee of the electrical exhibition of Paris, in 1881, was adopted as a basis for the observations of the intensity of the magnetic earth-currents. The end of the year 1885 was named for the conclusion of the work of the various stations.

— Prof. F. H. Snow of the University of Kansas reports, that although the month of May was one of the coldest on record, yet it was marked by an entire absence of frosts. The rainfall was ample, though less than the average.

— Prof. W. B. Scott is now on his way to Montana with the fourth scientific expedition from Princeton, with the object of exploring the Wahsatch eocene of Wyoming and Montana.

— Professor Mushketoff will be sent by the geological committee of the St. Petersburg academy of sciences to explore the Kalmuk steppe (between Volga, Don, and Manikh). Later in the season he will make a geological exploration of the celebrated mineral springs of Piotigozsk and vicinity (northern Caucasus). This study is to decide many important questions about their protection and improvement. These springs are under direct government administration from the beginning of this year, after a long lease to a contractor.

— *Nature* announces the call of Dr. Hugo Gyldén, director of the Stockholm observatory, to the professorship of practical astronomy at Göttingen.

— The forthcoming volume of the Encyclopaedia Britannica, the seventeenth, extending from MOT to ORM, will contain the following articles: Navigation, by Capt. H. A. Moriarty, R.N.; Nebular theory, by Dr. R. S. Ball, F.R.S.; Newton, by Mr. H. M. Taylor of Trinity college, Cambridge; Nitrogen, by Prof. W. Dittmar; Nitroglycerine, by Sir Frederick A. Abel; Numbers, by Prof. A. Cayley; Numerals, by Prof. W. Robertson Smith; Numismatics, by Mr. Reginald S. Poole; Nutrition, by Prof. A. Gamgee;

Observatory, by Dr. J. L. E. Dreyer of Armagh; Opium, by Mr. E. M. Holmes; Optics, by Lord Rayleigh; Orchids, by Dr. M. T. Masters; and Organ, by Prof. R. H. M. Bosanquet.

— At the meeting of the Royal astronomical society, May 9, Prof. C. Pritchard of Oxford read a paper on the proper motions of forty stars in the Pleiades, which he has determined from a comparison of Bessel's heliometer-measures with recent micrometric measures made at Oxford, and also with the positions determined ten years ago by Wolf at the Paris observatory. The existence of certain small proper motions of these stars in different directions is interpreted as indicating the mutual interference of a group of gravitating bodies. At the same meeting of the society, Dr. David Gill, her Majesty's astronomer at Cape Town, described the mounting of the great thirty-inch refractor now constructing at the shops of the Messrs. Repsold, at Hamburg, and which is to be set up this year at the Pulkowa observatory, near St. Petersburg. The tube of the telescope will be about fifty feet long; and the mechanical arrangements of the mounting will be so thorough and convenient in use, that a single assistant, sitting at the lower end of the polar axis, will be able to point the instrument accurately to any part of the heavens. A paper was likewise read by Mr. A. A. Common of Ealing, proposing the application of his method of relieving the friction in the axes of large instruments, to the polar axis of a large equatorial telescope. In his plan, somewhat similar to that of the Repsolds, the centre of flotation in a bath of mercury is vertically underneath the centre of gravity of the polar axis and telescope combined. The Repsolds employ, instead, a friction-roller under the centre of gravity to support the Pulkowa telescope.

— Dr. A. Berghaus has called attention in *Ausland* to the successful revival of the use of fibres derived from the nettle, as a material for spinning and weaving. That the common stinging nettle was formerly largely used in Germany to afford a material for the making of woven fabrics, is proved in an interesting manner by the fact that the old German name for muslin literally means 'nettle-cloth' (*nesseltuch*). Before the new material was introduced, the fabric most nearly corresponding to the new cloth must, undoubtedly, have been made from the nettle, and, as in many other cases, the name remained (at least for a time) after the thing was changed. But on the introduction of cotton from America, the nettle soon fell into neglect; and it was not till comparatively recent years that attention was again called to it. After the exhibition at Philadelphia, when the German manufacturers saw that they must do something to put themselves on an equal footing with rival nations, Professor Reuleaux, their representative in America, strongly advised them to pay more heed to the products of their own soil in order to make themselves less dependent on foreign supplies, and, among other plants suitable for the purpose, he reminded them of the nettle. An enterprising lady took the matter up practically, and, in the end, with the most gratifying success. She planted nettles on a part of her estate composed of poor stony ground, covered only with a thin layer of soil, and, at an agricultural exhibition held in the autumn of 1877, she was able to exhibit nettle-fibres in all stages of preparation up to yarn. This success convinced the unbelievers; and hundreds thereupon began to cultivate nettles, not only in Germany, but also in Switzerland, Belgium, Hungary, Poland, Sweden, Austria, and even in this country. Two years later the first German manufactory devoted to the new industry was opened at Dresden. The experiments made there at first were not altogether satisfactory; but, after repeated attempts, a yarn was produced which left nothing to be desired. In this manufactory the common nettle is used to some extent, but the best results are obtained by using the Chinese nettle, which yields a fine glossy yarn, of greater strength than the common nettle. The fibre is hence known as China grass.

— In the first number of the *Jahrbuch der Deutschen malakozoologischen gesellschaft* for 1884, Heynemann continues his studies of little-known genera of slugs. From an examination of the type-specimen, he shows that Aspidoporus of Fitzinger is founded on a malformed individual of Amalia carinata. The genera Urocyclus, Elisa, and Dendrolimax are also discussed. Brusina, in a paper on the Neritodontas of Dalmatia, indulges in a lively polemic with relation to some rather peculiar publications by Bourgnignat. Both papers are illustrated. In the accompanying *Nachrichtsblatt*, Simroth discusses the European and especially the German slugs, a group of the Pulmonates which has recently excited much interest. Simon and Boettger describe the land-shells of the Cottish Alps, and Kobelt describes some new operculated land-shells from the Philippine Islands.

— At the *séances* held during April by the Société française de physique, in the rooms of the observatory, the curious experiment of using a gloved hand as a telephone-receiver was exhibited. Fig. 1 shows the apparatus used, P and M being a battery and a microphone-transmitter in the main circuit; B, an induction-coil with the break-circuit closed; while P' is a battery, and R, ordinary holders for receiving a shock.

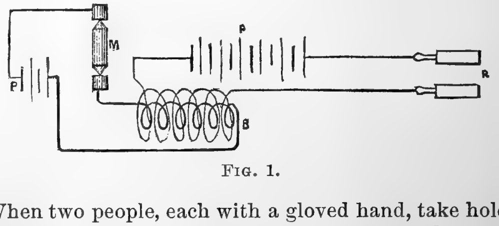


FIG. 1.

When two people, each with a gloved hand, take hold of the two holders with their bare hands, and one of them holds his gloved hand over the ear of the other, any conversation or music near the microphone becomes audible to this other; or, if they hold one another's ears, both may hear. By leaning their heads together, so that their ears would touch except for a sheet of paper placed between them, the same result was obtained. It was also found possible to do away

with the stretched membrane, the glove or paper, and for a third person to hear the conversation in the bare hands of the two holding the electrodes, when these two held his ears as shown in fig. 2. It has even been possible to render the sounds audible to a chain of people, each holding the ear of his neighbor.

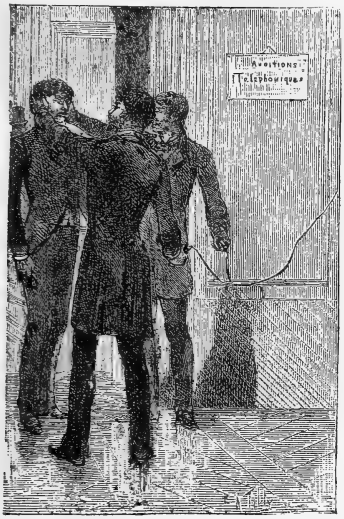


FIG. 2.

— In the report of the meeting of the Royal society of Canada, published in *Science* for June 6, it was stated that Mr. F. N. Gisborne had devised a new method of getting rid of the cross-talk in telephone cables. The device, that of the use of a metallic circuit of wires near one another, was patented by A. Graham Bell in England in 1877, and later in the United States.

— Dr. Palisa has had a declinograph, on the plan of Dr. Knorre's at Berlin, fitted to the twelve-inch Alvan Clark refractor at Vienna, and he is observing zones with even greater assiduity than usual. He reports himself as satisfied with the working of the instrument, which gives positions accurate to about $0^s.2$ and $2''$. In a zone 25^m by $20'$ a hundred and fifty stars can be registered. The positions are to be reduced to 1875.0, and this is chosen as the equinox for all the new Vienna maps. Each map is to have a catalogue of its stars accompanying it, which is an excellent addition. Dr. Peters's catalogue of sixty thousand zone stars would be of great usefulness, if it were available, as a supplement to his splendid series of celestial charts.

— Prof. W. Preyer of Jena is publishing a '*Specielle physiologie des embryo*' in four parts, of which the first two have appeared. It is written from a purely medical stand-point; for it discusses really human embryology, drawing upon mammals, birds, and other lower forms, for illustration. In spite, however, of its narrow scope and one-sided view, it is a valuable treatise. By the collation of the researches previously published, and the addition of some observations of his own, Preyer has compiled a work which reveals an extent of positive knowledge in this obscure field, which few would have anticipated. In the parts before us, the circulation, respiration, and nutrition of the embryo are very fully treated. The work is excellent, and, without doubt, will do much towards dispelling some of the crude and erroneous conceptions still prevalent in regard to the physiology of the mammalian embryo.

— The French geographical societies will hold their seventh general congress in the month of August at Toulouse. Geographers of several adjacent countries, especially of Spain, are expected to participate in the proceedings. The municipality has devoted a sum of twenty thousand francs to the expenses of the local committee, of which Dr. Ozenne is president, and Commander Blanchot, general secretary.

— An international fisheries, ornithological, and hunting-appliances exhibition is planned for 1886, in Vienna.

— A new expedition to Greenland has started from Copenhagen: it consists of Lieut. Jensen, Lorenzen as geologist, and the painter Rüs-Carstensen. The object of the expedition is the exploration of the west coast of Greenland between Holstensborg and Lukkertoppen. They expect to return in October.

— Prof. F. A. Forel of Morges reports that the glaciers of Mont Blanc, after decreasing for a considerable time, are now again advancing. Professor Forel has for many years recorded his observations on the Mer de Glace.

— A botanical section of the Cincinnati society of natural history was organized June 7, under the chairmanship of the curator of botany in the society. Its object was stated to be, to bring together those interested in the study of botany for the purposes of mutual encouragement and benefit, the investigation of the flora of the vicinity of Cincinnati, and the formation of a local herbarium. A number of specimens of plants were exhibited, and two or three new additions to the flora were announced. One of these was Matricaria discoidea, from near Loveland, O., — a very late introduction.

— There is no truth, the *Athenaeum* states, in the rumor that Mr. Herbert Spencer purposes paying a visit to Australia. His trip to the United States injured his health too seriously to induce him to try another experiment of a like kind on a much larger scale. Though still suffering from impaired health, he is happily able to devote a portion of his time to his favorite studies.

— Lieut. Frederick Schwatka, the arctic explorer, has resigned his position on Gen. Miles's staff, and will join his regiment in Arizona. The Russian geographical society has awarded its silver medal to Schwatka for his explorations.

— Dr. Griffiths sends to the *Chemical news* of March 7 a note on the formation of the recently discovered paraffine shale deposits of Servia, which he thinks coincides with the results of his other investigations. These deposits are situated on the River Golabara, in the western part of Servia. The shale occurs in upheaved cliffs about two hundred feet

above the surrounding plain. The formation consists of hundreds of layers of white and gray shale, one above the other, sometimes being separated by small beds of clay of a whitish color, containing rock-salt, and sodium and manganese sulphides. It is stated that this part of the country strongly resembles the paraffine and salt districts of Galicia. It has been known for ages that cattle and birds resorted to these cliffs to eat the clay containing the rock-salt, but the quality of the shale remained unknown until a year ago. The paraffine shale is entirely free from bituminous impurities, it is nearly white in color, and has no odor. When heated to about 800° F., it takes fire, and burns with a clear, bright, smokeless flame, leaving a gray ash behind. The deposits are of marine origin and eocene period. Eruptive porphyritic and trachytic rocks are plentiful at a distance of five or six miles. In the clay-beds (which are peculiarly free from ferric oxide) large numbers of the fossil remains of the eocene period are to be found. It is thought, that, in the limestone rocks which underlie these shale deposits, rock-salt and petroleum wells may be found. A sample of the paraffine shale yielded, on distillation, 2% of a semi-solid hydrocarbon somewhat similar in appearance to ozocerite wax, which, on extraction with 'benzoline,' gave 1.75 % of wax. It also contains 3.02 % of water of combination, and 1.18 % of ammonia; the remaining ingredients being mineral constituents. It is stated that the mineral constituents of these paraffine shale deposits would make a useful hydro-cement, and could easily be obtained by open quarrying: they could be used as fuel with gas-retorts. They lie within easy reach of the Danube.

— The death is announced of Sir Sidney Smith Saunders, a leading English entomologist, who had made the Strepsiptera — a curious group of minute beetles parasitic on Hymenoptera — his special study.

— The medical congress in Berlin, in April, was very well attended, and most of the prominent medical questions of the day were discussed. The meeting opened with a paper on true pneumonia, which Professor Jürgensen considered infectious. Very opposite opinions were expressed during the discussion. Reflex action, and vaccination, followed. On the second day, diphtheria was the subject most discussed, which Dr. Löffles considered to be a local affection, caused by a chemical poison; but the theory found an opponent in Dr. Heubner of Leipzig. Professor Weber of London read a paper on school hygiene in England, and recommended medical inspection of schools. Nervous dyspepsia, and other nervous affections, filled up the rest of the discussions. Professor Rosbach of Jena read the report of the commission on the treatment of infectious diseases. Next year the congress will be held at Wiesbaden.

— As is well known, the work of excavating in the Tigris-Euphrates valley, the seat of the old Babylonian-Assyrian empire, has been carried on vigorously for the last forty years, and a vast mass of material has been collected and brought to Europe. Many thousand historical and commercial inscriptions, copies of ancient epic poems, magic rules and formulas, religious hymns, and specimens of architecture and sculpture, are now to be found in the museums of London, Paris, and Berlin. The most of this work has been done by the English. The cuneiform collection in the British museum is by far the richest in the world. Mr. Rassam, a wealthy Syrian gentleman of London, is now devoting all his time to excavating: he goes out every year, and brings back to England a larger or smaller quantity of tablets and other Assyrian remains. Already there is enough Assyrian material in the British museum to occupy scholars for the next fifty years. But the field is large; and there is room for other exploring parties, without danger of encroaching on the English domain. American Assyriologists have for some time felt the desirableness of having a collection of cuneiform material in this country; and last autumn some gentlemen interested in the matter held a conference, and determined to make the attempt to organize an expedition to Mesopotamia. It was thought best that the first attempt should be in the way of exploration and survey of the ground, in order to fix on the best points of work, and come to an understanding with the English parties now in the field. In spite of some unfavorable conditions, the preliminary arrangements have now been completed. The money is assured, Miss C. L. Wolfe of New York having given the whole of the sum which it was computed would be required. In accordance with her desire, the expedition will be called, in honor of her father's memory, 'the Wolfe expedition;' and this name will be, in the feeling of the public concerned, a no less fitting tribute to her most praiseworthy liberality. The gentlemen who have been selected to go out are Messrs. W. H. Ward, editor of the *New-York independent*, and J. T. Clarke and J. R. S. Sterrett, lately of the Assos expedition, — all proved men. The expedition has received the indorsement of the Archeological institute of America, in whose name it will go out. The department of state has promised to use its influence to procure the necessary firman from the Ottoman government. The purpose is to try southern Mesopotamia, the old Babylonia, the seat of the oldest civilization, and the portion of the country which has been less explored than any other. It is believed that here, and in the opposite region across the Tigris, there is probably abundance of early material. If this preliminary expedition should report favorably on its return, an effort will then be made to organize an excavating party immediately, and begin serious work. In the region had in view there are not only Babylonian-Assyrian, but also more modern Arabic and Syriac treasures to be hoped for; and the explorers will be instructed to gather all that they can find. The present expectation is that Dr. Ward will sail for England about September next. In London he will find Mr. Clarke, who is engaged in working up his Assos report; and the two will be joined by Dr. Sterrett, who is now in Athens, where, during the sickness of Professor Packard, he has been in charge of the American school of classical studies.

SCIENCE.

FRIDAY, JUNE 27, 1884.

COMMENT AND CRITICISM.

The new and promising biological department of the University of Pennsylvania has issued a modest prospectus, announcing opportunities for special work, and courses of instruction in biology, open to both sexes. A high ground is taken in its simple 'aim,' which is avowed to be, "to encourage original research in biology by offering facilities to scientists engaged in investigation, and by giving instruction to advanced students prosecuting special work." Besides this principal function, "the department will further conduct the instruction of those students of biology . . . in a course leading to the degree of doctor of philosophy, and of those . . . who have elected the course preparatory to the study of medicine." A suitable laboratory is to be ready by Sept. 1, and is to possess one feature which cannot be too highly commended; viz., "private rooms for the use of investigators." There is as yet no symptom of any attempt to force investigation unduly, and let us hope there never will be. Investigators are born, not made; and now that the first step has been taken in promising them 'facilities,' the next will quickly follow; viz., to supply a stimulus. For this, example is better than any mechanical pressure; and to the faculty we must look for the healthy stimulus of example. Last, but by no means least, the university or its friends should see to it that a moderate pecuniary support shall be obtainable in the shape of fellowships or otherwise; so that poverty may never be permitted to interfere too far with the real investigator.

During the past two years, great interest has been manifested in the subject of the unification of time and longitudes the world over. In our own country, the universal adoption, in November last, of standard time according to a system of meridians distant from that of Greenwich by an exact number of hours, has led to results of great importance in the convenient arrangements and intercourse of ordinary life. Though not at all a matter of necessity, it is still desirable that this system of standard meridians, or some other, shall be adopted everywhere; and, in pursuance of an act of congress, the president of the United States has invited the principal nations concerned to send delegates to a time-convention, to meet at Washington next October, to deliberate upon the question of the adoption of such a prime or zero meridian. By far the greater part of all calculations in geography, astronomy, and geodesy, where a zero meridian is concerned, are, by common consent, referred to the meridian of the observatory at Greenwich, England; so that this meridian stands among the first proposed for universal adoption. The representatives of other governments, however, will undoubtedly have decided preferences for other meridians; and there is much to be said in favor of the adoption of one or another zero point of reference. The interest in this subject is plainly apparent from the fact that nearly all of the invited nations have appointed suitable delegates, whom our own commissioners will at an early date be expected to receive at Washington.

It goes without saying, that the learned men of other lands, thus convened, will expect to see our own nation represented by its highest order of talent, especially as the convention has been called by ourselves. And it is particularly desirable that our own commissioners shall be men of the greatest scientific authority in these matters; for, as the representatives from foreign countries are our guests, they will the more readily accept proposals from our commissioners, should these representatives prove competent to take a very prominent part in all the deliberations of the congress, as

scientific men of the first rank. It may also fairly be supposed that the French language will be more generally spoken by the delegates from all nations; and the necessity of a thorough acquaintance with the French and German languages ought to be duly weighed by those having power to make the appointments of the American commissioners. The power of appointment having been apparently delegated to the secretary of state, no sufficient reason is apparent why this officer, whose appointments to similar positions of responsibility have heretofore been excellent, should have transferred his prerogative, in part, to the secretaries of war and the navy, the former of whom has not yet, it is believed, made his own designation.

The time-convention act provides for the appointment of three commissioners. On general grounds, the appointment of President Barnard by Secretary Frelinghuysen himself is open to no objection; for he has long been interested in these matters, occupies a commanding position, is a scientific man of recognized ability, and has had, in addition, much practical experience in international conferences. His personal disability of extreme deafness ought, however, we think, to have excluded him from membership of the commission, as it will practically prevent his taking a leading and representative part in its deliberations. The second commissioner, already named by the secretary of the navy, is not open to any such objection: but he is practically unknown in science, outside of a limited circle in the United States; and, aside from his being at present on duty at the naval observatory, there is very little reason why he should have been selected for this responsible scientific appointment, rather than any other line-officer of the navy; and, besides, we are credibly informed that he speaks no language but English.

It remains to be seen what name the secretary of war will designate; and it is to be hoped that he may consider well the appointments already made, and add by his own the strongest possible name to the list of commissioners. Unless we mistake, he is not required to make the appointment from the army, but may select from the ranks of scientific men in general. Had Mr. Frelinghuysen asked the secretary of the treasury for a name, and had he designated the superintendent of the coast-survey to act as commissioner, we should have had an officer in all respects competent to represent the interests of the nation. Nor had any one the power to make a wiser appointment than lay in the way of the secretary of the navy, — to detail the superintendent of the 'Nautical almanac' for this service. This condition of affairs, in so far as the present appointment of the American commissioners is concerned, points to the advisability of additional legislation on the subject. Congress should at once supplement the commission by not less than two additional members, and stipulate that these be recommended to the president (as the original commission might well have been) by the president of the National academy of sciences; thus making the matter one in which the advice of the academy is sought by the government, and which, by its act of incorporation, the academy is required to give. The appropriation of a moderate sum to defray the necessary expenses attending the sessions and records of the deliberations of the convention, ought also to be granted. This, indeed, we understand, has already been proposed.

THE call made by the Peabody museum for immediate funds for the continuation of its explorations in Ohio deserves to meet with a cordial response; and, were the valuable and novel results which are being secured by this exploration more widely known, there would be no doubt as to its success. Probably, for the first time in all the years that have passed since the Ohio mounds and earthworks have excited the curiosity of the people, a thoroughly scientific and exhaustive exploration is making of one locality. This is not merely to collect relics from the mounds, which has heretofore

so often been the single purpose of so-called exploration; nor is it carried out by sinking shafts in the centre of a mound, or cutting a ditch or two through it: but every foot of earth is removed, and the whole structure laid bare foot by foot. This mode of work has led to the discovery of singular and remarkable structures, not only in the mound and at the natural level of the surrounding land, but for six feet beneath this, to the underlying gravel-deposit. These operations have brought so many novel facts to light, that we have now the right to class all former mound-explorations in the Ohio valley as so superficial as to be scientifically worthless, until further thorough work on groups not yet destroyed shall give the means of comparison, and place the partial results that were formerly obtained in their proper relations.

The recent explorations have shown conclusively that the mounds and earthworks in various parts of the country were made at greatly different periods of time, and presumably by different peoples, even should it be ascertained that they all belonged to the great Mongoloid stock, of which our Indians probably represent more than one subdivision. This, however, is not yet proved; and the conclusions that have been drawn from time to time, that there has only been one people on this continent who made the earthworks of various kinds, are too hasty deductions from the present imperfect knowledge of our archeology. That some Indian tribes made mounds and earthworks and fortifications is not to be questioned, and that others did not is probably equally true; but this does not give us the right to throw overboard other facts tending to show that peoples of various stages of development, and, so far as craniological and artistic conclusions can be at present drawn, of distinct ethnical stocks, were also former inhabitants of this continent. One man will class all the past and present native inhabitants of all America, both north and south, as Indians; the next, with equal assurance, will state that the ancient Mexicans, the builders of the stone structures in Yucatan, the old Peruvian and other South-American nations, etc., were races distinct from the North-American Indians; and there have been many variations from these theories.

The fact is, we do not know who the Indians are, or who were the old builders of Palenque, of Uxmal, of Tiahuanuco, and numerous other old cities from Mexico to the eastern side of the Andes in South America. Until we awake to the fact that America has an interesting past, and can arouse ourselves to the effort of making out the ancestors and descendants of all these peoples, who have left us such marked differences in their architecture, their works of art, their customs and their languages, we act the part of amateurs, when from a little knowledge of a few of these different conditions, and from superficial or very general resemblances, we draw hasty conclusions. Only the most thorough explorations, conducted by men who have broad views and careful methods of work, — men who are above being led by theories to be maintained; who will look at facts in the same manner as a geologist or a biologist looks at his facts, letting them lead him where they will, — will solve for us the great problems of American archeology. The days of collectors of curiosities and hasty writers are over. Archeology is a science, and no longer in the hands of the mercenary dealer and the equally avaricious collector of curiosities. Give the proper institutions the support they ask for, and the near future will bring valuable results.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Gyration of a vibrating pendulum.

IF a body move in any curve about any centre of curvature, the inertia of the body is manifested as a force acting in the plane of the curve, and in a direction opposite to that of the centre of curvature; and if v denote the lineal velocity of the body, and ρ its distance from the centre of curvature, the force thus manifested will be represented by $\frac{v^2}{\rho}$, and is called the centrifugal force due the motion.

If the body move in a straight line on a limited portion of the earth's surface while the earth is rotating on its polar axis, its motion may be regarded, without sensible error, as being on a tangent plane; and because any tangent plane rotates about an axis

normal to that plane, with a constant angular velocity $\omega \sin \lambda$, where ω is the angular velocity of the earth about its polar axis, and λ is the latitude of the normal axis, the path of the body, in space, will evidently be a spiral curve; and from the properties of that spiral, the centrifugal force at its origin, which is the deflecting force resulting from the earth's motion on its axis, is readily found to be $2\omega v \sin \lambda$ (see *Science*, iii. No. 57).

The same result that is here found from the properties of the spiral which the body describes in space was found by Mr. Ferrel from the equations of motion on a spherical surface (see eq. 53, Professional papers of the signal-service, No. viii., 1882, p. 30); but, by assuming that the motion of the body in space is in the circumference of a circle, he finds for the time, τ, of a revolution in that circumference, —

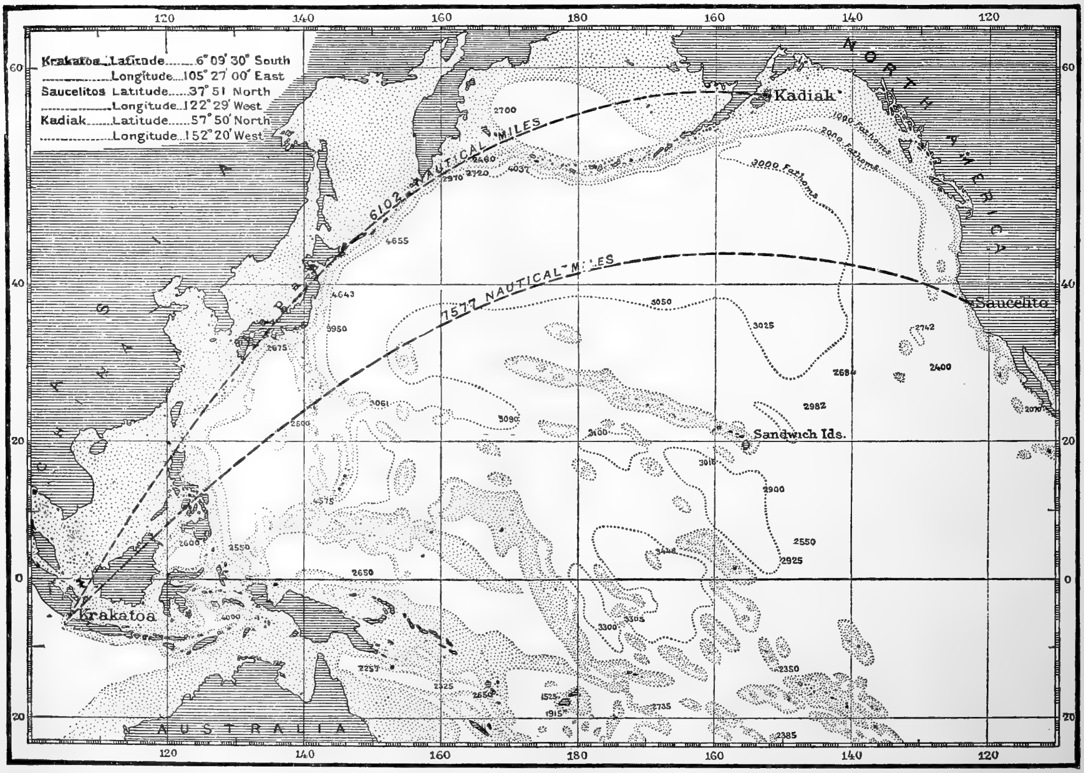
'$\tau = \sec \theta \times \frac{1}{2}$ day;'

and he says, "The gradual gyration of a vibrating pendulum is caused by this same deflecting force, and hence the time of gyration is the same as that of τ in the preceding equation."

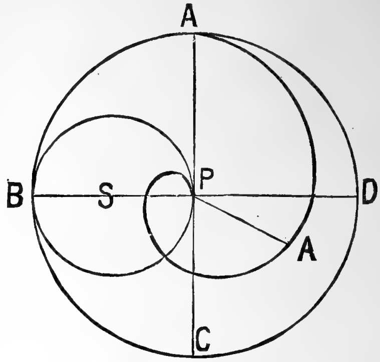
But it is well known that the time of gyration of a vibrating pendulum is $\sec \theta \times 1$ day.

This discrepancy may be explained as follows: —

Let P represent the position of the normal axis or centre of the tangent plane $ABCD$, which therefore



rotates about P with the velocity $\omega \sin \lambda$, or $\omega \cos \theta$, if we adopt Mr. Ferrel's notation; and because the radius of curvature at P is the same for the spiral $PA'A$ as for the circle s, the centrifugal force at P will be the same, whether the body move in the spiral, or in the circumference of the circle s: but if we suppose the body to describe the circumference of the circle s by moving along the radius vector PA', while the radius vector rotates about P, the circumference of s will obviously be described while the



radius vector makes a half-revolution about P; that is, in the time $\tau = \sec \theta \times \frac{1}{2}$ day. The time τ' of gyration of a vibrating pendulum, however, does not correspond with the time τ in which the circle s would be described, but is the time in which the spiral $PA'A$ is described, and hence —

$$\tau' = \sec \theta \times 1 \text{ day},$$

as has been abundantly proved by experiment.

J. E. HENDRICKS.

Des Moines, Io., May 29.

Water-waves from Krakatoa.

You published, in May, a couple of interesting communications on atmospheric waves from Krakatoa. As the effect through the water was still more marked and more sharply defined at very great distances, I have made for publication, by authority of the superintendent of the U. S. coast and geodetic survey, reduced photographic copies of the records of the self-registering tide-gauges at Kadiak, Alaska, and at Saucelito, near San Francisco. These copies cover the period from 0*h*. Aug. 27, to 0*h*. Aug. 30, or the seventy-two hours during which the tide-gauges show, in a very marked manner, the effect of the Krakatoa earthquake upon the masses of water in the North Pacific Ocean.

It is interesting to notice that the impact of the earthquake was apparently felt earlier and in a greater degree at San Francisco than at Kadiak; although the former is 1,473 geographical miles more distant, in a direct line, from Krakatoa.

The observations at Honolulu, where the U. S. coast and geodetic survey has a self-registering tide-gauge, are expected to arrive shortly, and will help to throw more light on this interesting point.

All this suggests inquiry into the path which the great wave pursued. According to the accepted theory of wave-transmission in deep waters, the time is shortest in the most profound depths, and therefore the tidal register at Honolulu is looked for with great interest. There are evidently several pathways through the great congeries of islands north-east of Krakatoa, and two to the south of Australia, — one between Australia and New Zealand, thence through the Pacific; and the other east of New Zealand, and northward through the Pacific. (See opposite map.)

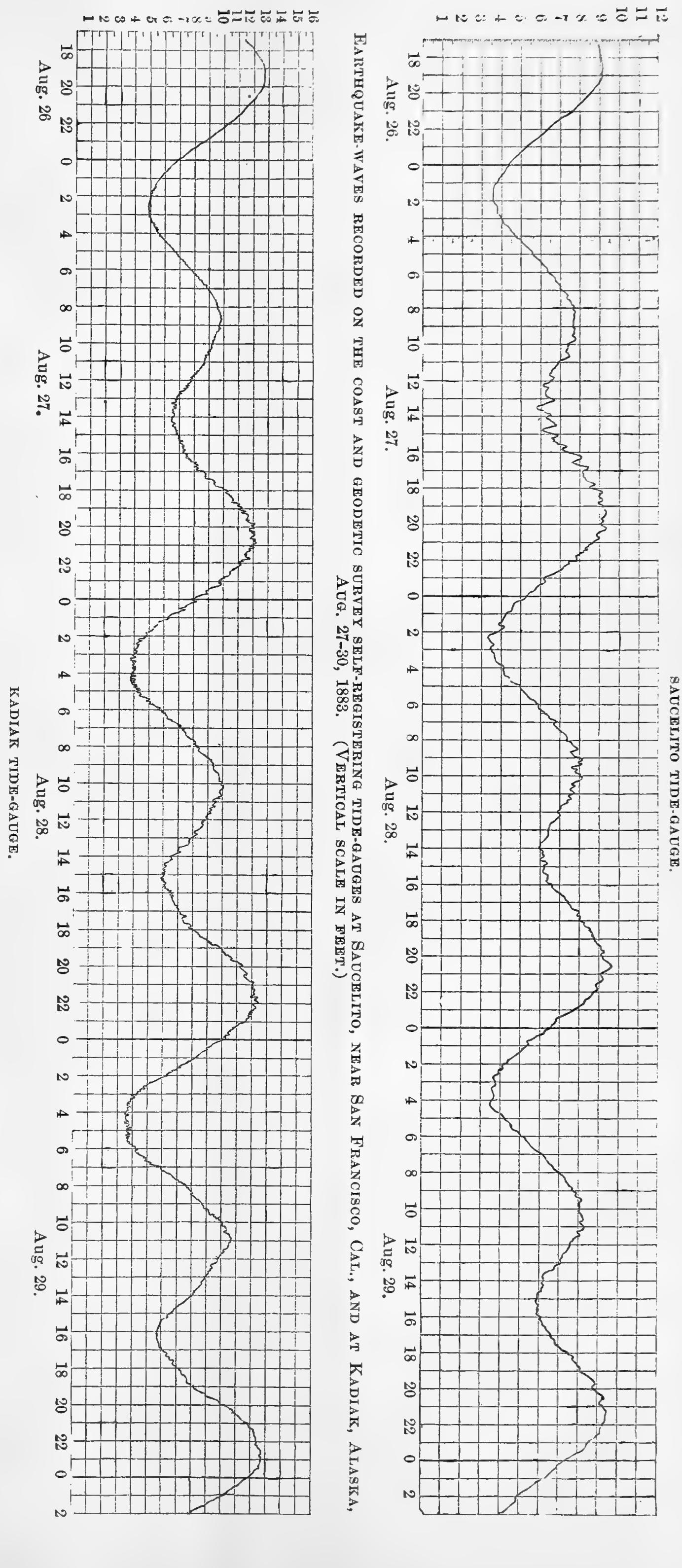
If it had been possible to maintain the tide-gauge at Mazatlan, it would have afforded very valuable information as to the most probable direction taken by the great earthquake-wave.

The dates upon the records are given for local mean solar time, 'civil account' at each gauge. The temperatures recorded are of the water at the time indicated. The geographical positions are as follows: —

Krakatoa . .	lat. 6° 09.5′ S., long. 105° 27′ = 7*h*. 01*m*. 48*s*. E.
Saucelito . .	lat. 37° 51′ N., long. 122° 29′ = 8*h*. 09*m*. 56*s*. W.
Kadiak . . .	lat. 57° 50′ N., long. 152° 20′ = 10*h*. 09*m*. 20*s*. W.

C. O. BOUTELLE,
Asst. in charge of office.

U. S. C. and G. survey,
Washington, D.C., June 10.



EARTHQUAKE-WAVES RECORDED ON THE COAST AND GEODETIC SURVEY SELF-REGISTERING TIDE-GAUGES AT SAUCELITO, NEAR SAN FRANCISCO, CAL., AND AT KADIAK, ALASKA, AUG. 27-30, 1883. (VERTICAL SCALE IN FEET.)

THE U. S. CENSUS OFFICE.

THERE is a popular disposition to belittle the importance of the census, and to underestimate the value of what has been accomplished under the direction of Gen. Walker, which will pass away when the magnitude of the difficulties to be overcome, and the skill displayed in handling such a mass of figures, are better understood by the public. Six volumes have already been issued, which have excited the admiration and enthusiastic approval of statisticians on both sides of the Atlantic. It is said that the whole number of volumes will be nearly twenty, of which some are now in type, others ready for the compositor, and of a part the manuscript copy is not yet fully prepared. The entire series will constitute an encyclopaedia of information, not only as to the population of the United States and its composition and growth, but as to the financial and other resources of the country, and the burdens to be borne by the American people, and will be of the greatest historical value. As an advertisement of the national wealth, and of the rapidity with which this country is assuming a foremost position among the nations of the earth, the tenth census is worth many times its cost; and we are not claiming too much for it when we venture the assertion that no statistical work of equal extent and merit has ever been executed by any nation.

The unpopularity of the census appears to be due, partly to its having exceeded in cost the original estimate, and partly to the delay in the publication of the results. But it is not surprising that Congress was unable to foresee the actual amount of expense involved in so elaborate and exhaustive an inquiry; and the delay in publication is owing to insufficient appropriations from time to time, and the too rapid reduction of the force engaged, which has unduly prolonged the examination and tabulation of the returns. It is probable, also, that the failure to ask and obtain sufficient appropriations has curtailed the proportions of the work, and led to the omission of information which was in fact gathered, and might have been given to the world.

Really it is more than doubtful whether the methods adopted for taking the census do not need to be thoroughly revised, and new methods adopted. It must be a serious loss to the government to do as it does, — to disband the force trained for this special undertaking, and scatter it, once in ten years, and then reorganize it with unskilled and inexperienced clerks, who require to be educated at great expense before they understand what it is that they are employed to do. No other scientific undertaking is carried on in this way. We assume that the purely clerical portion of the work may be done by untrained clerks, if they are directed by skilled and competent chiefs of division, just as raw recruits may be of service in war, when drilled and commanded by veterans. But it would seem that the office of commissioner or superintendent of census ought to be made a permanent one, and work enough assigned to this bureau to employ a permanent staff of assistants capable of giving impulse and direction to the largely augmented number of clerks required when the decennial enumeration of the population is made. There are many varieties of social statistics which it would be desirable to collect and publish annually; and it is not essential that all the special and occasional investigations which are of national importance should be made at the same moment of time. Why might not the population be enumerated in one year, and the agricultural statistics obtained in another, and so on? Then, too, it is difficult to conceive how a census can properly be made without reference to documents, state and municipal, which should be permanently preserved in a special library under the control of the office, with a librarian charged with the duty of keeping it up, and thoroughly acquainted with its contents and arrangement; which implies a permanent census bureau. Lists of correspondents are also requisite, which should be constantly revised and corrected. The additional expense of a permanent force, which need not be large, would be far less than the waste of money occasioned by the want of thorough preparation for taking the census on the present plan, and the mistakes and misdirected energy of a clerical force destitute of scientific knowledge or skill, unacquainted with each other, and unorganized for effective work.

There must also be improved modes of collecting and digesting information which are practicable. The process of tallying results by hand, so painful and slow, which is at present in vogue, must give way to some other process, involving less mental and manual labor, and increased accuracy. Too many clerks and too much time are required to meet the wants of an active and impatient people like ours. We do not appreciate information which is not recent and fresh. There must be some way devised of utilizing steam or electricity in the tabulation of results. If this can be accomplished, then instead of waiting several years for the published census, as we now have to do,

we might hope to have it on the shelves of our libraries in six months, or a year at most, after it is taken.

These remarks are made purely in the interest of science. Scientific investigation deals, first, with the elementary substances of which masses are composed, then with the forces which are at work to combine them into composite forms, and finally with the relations and principles which characterize and control organisms. Human society is an organism, for the right apprehension of which it is as essential to accumulate facts, and by means of comparison and analysis to deduce the laws which govern social phenomena, as it is to follow the same method of study in any other branch of science. The political and commercial bearings of the census we do not discuss; but it is evident that the census of the population and material resources of this country has for us a special significance, in view of our representative form of government and of the unprecedented growth of the American people. To these considerations may be added another; namely, that no other nation has such a heterogeneous population, and therefore such need of self-introspection, in order to comprehend its true capacity, limitations, and destiny. The political and financial needs of the country minister to science, and promote scientific research in this particular direction. All that scientific men insist upon is, that the investigation shall be in competent hands, and conducted according to the principles and methods which have done so much for science in general. A census bureau, wisely constituted, might, with respect to social science, occupy a relation, and perform a work, similar to that of the Smithsonian institution in the domain of the natural and physical sciences.

HEAD WATERS OF THE ATNA OR COPPER RIVER.[1]

VERY little has been known of this river, which enters the Pacific in about latitude 60° north, longitude 145° west. Several prospectors were left there tomake explorations last year, and will be called for this summer. The Ah-tena or Atnah Tinneh Indians reside on its banks, and from its bed have been taken numerous pieces of native copper resembling that of the Lake Superior region. The Wrangell Volcano is situated near it, about a hundred miles from its mouth.

In crossing the Chilkat portage from the head of Lynn Canal to the head waters of the Lewis branch of the Yukon, the head waters of another stream, called the Altsek River, are crossed. The natives allege that this stream falls into the sea; and on Tebienkoff's charts the mouth of the Altsek River is placed on the ocean-coast just north-west from Mount Fairweather, in the bed of the Grand Plateau Glacier. The observations of the U. S. coast-survey party, under my charge, in 1874 showed that no river from the interior could enter the Pacific between Cape Spencer and Yakutat Bay; all the depressions of the St. Elias Alps being filled with glaciers. In recent charts the Altsek has therefore been connected by a dotted line with the White River, one of the branches of the Yukon. I have for some time suspected that the Altsek was the head of the Copper or Atna River, but until lately have had no evidence sufficiently weighty to make it desirable to alter the charts. A recent letter from Dr. Arthur Krause states that his Indian guides told him that they had descended the Altsek to salt water, where there was a small village of Tlinkit Indians. This makes it certain that the Altsek and Atna rivers are continuous; for the Chilkhaat village at the mouth of the Atna is the only one answering to the situation, and the westernmost of all the Tlinkit villages, being separated from most of the others by a wide stretch of unoccupied coast.

This determination is of much importance. It determines the Atna River to be over four hundred miles in length, and the longest river falling into the Pacific between the Fraser in British Columbia and the Aliaskan peninsula. The opportunity for a most interesting exploration is here evident. The explorer need only take a couple of good canoes or portable boats up the Chilkat River, and across the portage to the Altsek, and float down the latter. Within a couple of days of the mouth of the Atna is the trading-post of Fort Constantine at Port Etches, commonly known as Nuchek, where supplies could be had and arrangements made for the trading company's vessel to convey the party to St. Paul, Kadiak Island, whence transportation to San Francisco could be had without difficulty, at some time during the autumn.

WM. H. DALL.

[1] Communicated by authority of the superintendent of the U. S. coast and geodetic survey.

THE ETOWAH MOUNDS.

IN *Science* of April 11 is an article by Mr. W. H. Holmes, on certain engraved shells and figured plates of copper found in southern mounds. As some of the most interesting of these articles were obtained from one of the

mounds forming the celebrated Etowah group near Cartersville, Ga., a description of the form, structure, and contents of this tumulus may be of interest to those who have read Mr. Holmes's article.

As this group has been repeatedly described and figured (see Jones's 'Antiquities of the southern Indians,' chap. vi., pl. i.; and an article by Col. Whittlesey in the 'Smithsonian report' for 1880, p. 624), it will be unnecessary for me to add more in this regard than to correct one or two errors.

The dimensions of the large mound marked *A* in the figure alluded to, as ascertained by the assistants of the Bureau of ethnology, are as follows: the slant height along the steepest slope, which I found by personal examination to be just about 45°, is eighty-five feet, giving a perpendicular height of sixty-one feet; the longer diameter of the level top a hundred and seventy-five feet, and the shorter a hundred and seventy, giving an area of about seven-tenths of an acre; the length of the roadway which winds up the southern slope is two hundred and one feet, and the width sixty-one feet. This roadway is described, in all the reports I have seen, as reaching the summit level. This is a mistake; as it stops short of the top by thirty feet slant height, or twenty feet perpendicular height. I can also state confidently that it never reached any farther up, as is apparent from a mere glance at the plan of construction. The remainder of the ascent, which is quite steep, was probably made by steps or ladders.

The mound in which the articles mentioned were found by Mr. Rogan, who excavated it on behalf of the bureau, and a vertical section of which is given in fig. 1, is the smallest of the three, and the one marked *C* in Jones's plate, and also in Col. Whittlesey's fig. 2. The measurements, as ascertained by Mr. Rogan, are as follows: average diameter at the base, a hundred and twenty feet; diameter of the level top, sixty feet; height above the original surface of the ground, sixteen feet. The form is more nearly that of a truncated cone than represented in the figures alluded to.

The construction was found, by very thorough excavation, to be as follows: the entire surrounding slope (No. 4, fig. 1) was of hard, tough, red clay, which could not have been obtained nearer than half a mile; the cylindrical core, sixty feet in diameter, and extending down to the original surface of the ground, was composed of three horizontal layers, — the bottom layer (No. 1), ten feet thick, of rich, dark, and rather loose loam; the next (No. 2), four feet thick, of hard, beaten (or tramped) clay, so tough and hard that it was difficult to penetrate it even with a pick; and the uppermost (No. 3), of sand and surface soil between one and two feet thick. A trench was dug from opposite sides to the central core; and, when the arrangement was ascertained, this central portion was carefully explored to the original surface of the ground.

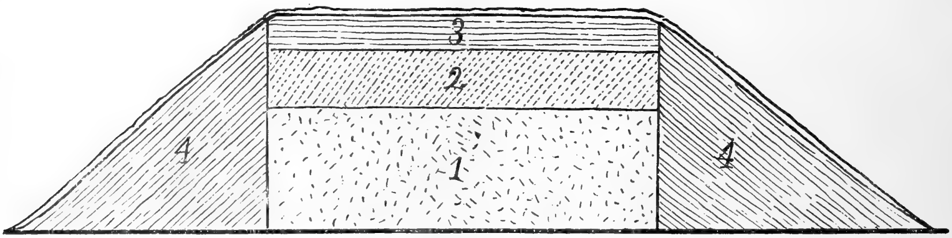


FIG. 1.

Nothing was found in the layer of clay (No. 2), except a rude clay pipe, some small shell beads, a piece of mica, and a chunkee stone. The burials were all in the lower layer (No. 1), of dark, rich loam, and chiefly in stone cists or coffins of the usual box-shape, formed of stone slabs, and distributed horizontally, as shown in fig. 2, which is a plan of this lower bed.

From Mr. Rogan's field-notes I quote the following description of these graves, mode of burial, etc.: —

Grave *a*, fig. 2. — A stone sepulchre two feet and a half wide, eight feet long, and two feet deep, formed by placing steatite slabs on edge at the sides and ends, and others across the top. The bottom consisted simply of earth hardened by fire. It contained the remains of a single skeleton, lying on its back, with the head east. The frame was heavy, and about seven feet long. The head was resting on a thin copper plate, ornamented with figures of some kind; but the head was crushed and the plate injured by fallen slabs. Under the copper were the remains of a skin of some kind; and under this, coarse matting, probably of split cane. The skin and

matting were both so rotten that I could only secure them in fragments. At the left of the feet were two clay vessels, — one a water-bottle, and the other a very small vase. On the right of the feet were some mussel and sea shells; and immediately under the feet two conch-shells, Pyrula perversa, partially filled with small shell beads. Around each ankle was a strand of similar beads. The bones and most of the shells were so far decomposed that they could not be saved.

Grave *b.* — A stone sepulchre four feet and a quarter long, two feet wide, and a foot and a half deep, differing from *a* only in size and the fact that the bottom was covered with stone slabs. The skeleton was extended on the back, head east. On the forehead was a thin plate of copper, the only article found.

Grave *c.* — A stone sepulchre three feet and a half long, a foot and a third wide, and a foot and a half deep; the bottom being formed of burnt earth. Although extending east and west, as shown in fig. 2, the bones had probably been interred without regard to order, and disconnected; the head being found in the north-east corner with face to the wall, and the remaining portion of the skeleton in a promiscuous heap. Yet there is no indication of disturbance after burial, as the coffin was intact. Between some of the bones I found a thin plate of copper that had been formed by uniting and riveting together smaller sections. Some of the bones found in this grave were saved.

Grave *d.* — A small sepulchre, a foot and a half square by a foot deep, contained the remains of an infant, also a few small shell beads. The slabs forming the sides and bottom of this grave bore very distinct marks of fire.

Grave *e.* — Simply a headstone and footstone, with the skeleton of a very small child between them; head east. On the wrists were some very small shell beads. The earth on the north and south sides had been hardened in order to form the walls.

Grave *f.* — Stone sepulchre six feet long, three feet wide, and a foot and a third deep, with stone in the bottom. Skeleton with the head north. There was a lot of copper about the head, which, together with the skeleton, was wrapped in a skin. The head rested on a large conch-shell (Pyrula perversa), and this on the remains of a coarse mat. Shell beads were found around the neck, each wrist, and ankle. On the right was a small cup, and on the breast an engraved shell. The copper had preserved a portion of the hair, which I saved; portions of the skin and matting were also secured.

Immediately under *b* was another stone grave or coffin, three feet long, a foot and a half wide and deep, extending north and south. The head of the skeleton was toward the north, but the feet were doubled back under the frame in order to get it in the allotted space. The only things found with this skeleton were some beads around the neck.

At *g* the remains of a child were found, without any stones about them. Some shell beads were around the neck and wrist, and an engraved shell on the breast.

Grave *h.* — A stone sepulchre a foot and a half square and a foot deep, stone slabs on the four sides and top, but the bottom consisting simply of earth hardened by fire. This contained only a trace of bones, and presented indications of at least partial cremation; as all around the slabs, outside and inside, was a solid mass of charcoal, and the earth was burned to the depth of a foot.

Grave *i.* — A stone sepulchre four feet and a half long, a foot and a half wide and deep, bottom earth, contained the remains of a skeleton resting on the back, head north, and feet doubled back so as to come within the coffin. On the breast was a thin plate of copper, five inches square, with a hole through the centre. Around the wrists were beads, and about the neck rather more than a quart of the same.

At *j* were the remains of a small child, without stone surroundings; under the head was a piece of copper, and about the neck and wrists shell beads.

These graves were not on the same level; the top of some being but two feet below the clay bed (No. 2), while others were from two to three feet lower.

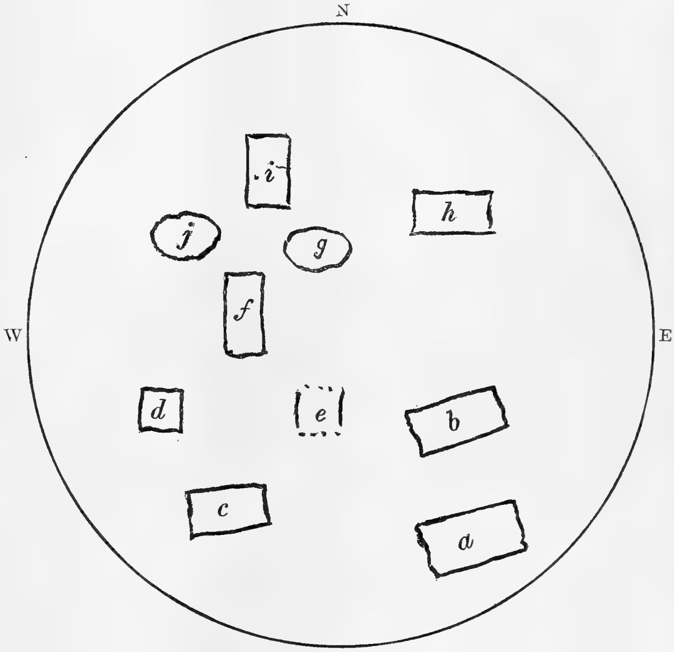


FIG. 2.

All the articles alluded to as obtained in this mound were forwarded at once to the Bureau of ethnology, and are now in the National museum. Examining them somewhat carefully since their reception, I find there are really more copper plates among them than Mr. Rogan supposed; the number and description being as follows: —

1. A human figure with wings, represented in fig. 5 of Mr. Holmes's paper, and repeated in our fig. 3. This is thirteen inches long and nine inches wide. A portion of the lower part, as shown by the figure, is wanting, probably some three or four inches. There is a break across the middle, but not sufficient to interfere with tracing out the design. A crown-piece to the head ornament is also wanting.

2. Also a human figure, shown in our fig. 4. Length, sixteen inches; width, seven inches and a half.

FIG. 3.

3. Figure of a bird, very similar to that represented in fig. 6 of Mr. Holmes's paper, but considerably larger, and varying slightly in details. This is imperfect, as part of the head, and the outer margin of the wings, are wanting. Length, thirteen inches and a half; width, seven inches and a half. This plate shows indubitable evidence of having been formed of smaller pieces welded together, as the overlapping portions can be easily traced. It has also undergone repairs: a fracture commencing on the left margin, and running irregularly halfway across the body, has been mended by placing a strip of copper along it on the under side, and riveting it to the main plate; a small piece has also been riveted to the head, and the head to the body; several other pieces are attached in the same way. The rivets are small, and the work neatly done.

4. An ornament or badge of some kind, shown in fig. 5. The two crescent-shaped pieces are entirely plain, except some slightly impressed lines on the portion connecting them with the central stem. This central stem, throughout its entire length and to the width of six-tenths of an inch, is raised, and cross-strips placed at various points along the under side, for the purpose of inserting a strip of bone; a part of which yet remains in it, and is seen in the figure at the break immediately below the point where the oblique strips meet. The most important and interesting fact presented by this specimen is the indubitable evidence it furnishes that the workman who formed it made use of metallic tools, as the cutting in this case could not possibly have been done with any thing except a metallic implement. A single glance at it is sufficient to satisfy any one of the truth of this assertion. Length of the stem, nine inches; width across the crescents, seven inches and a half.

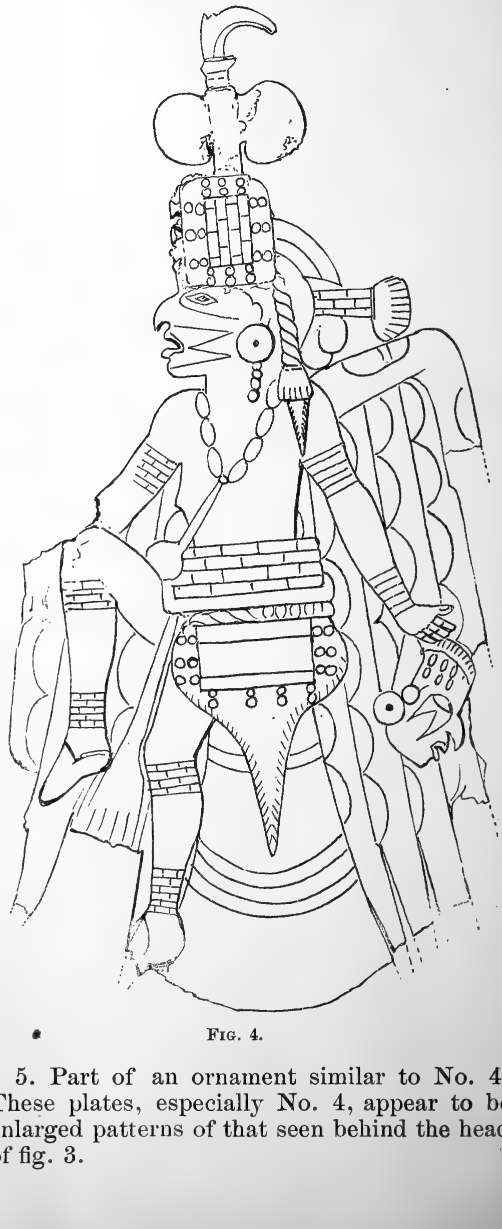


FIG. 4.

5. Part of an ornament similar to No. 4. These plates, especially No. 4, appear to be enlarged patterns of that seen behind the head of fig. 3.

6. An ornament or badge, shown in fig. 6, which Mr. Rogan, when he found it under the head of the skeleton in grave *a*, was inclined to

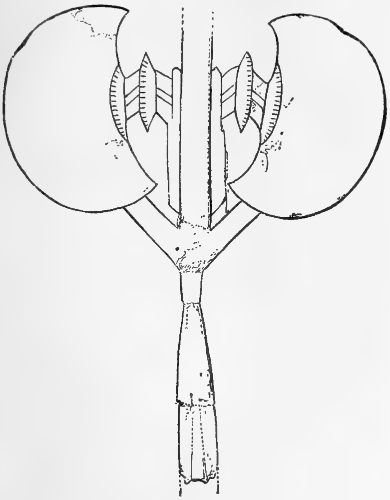


FIG. 5.

consider a crown. It is imperfect, a narrow strip across the middle and a portion of the tip being missing. As shown in the figure, it measures around the outer border nineteen inches and across the broad end three inches and a half. The six holes at the larger end, in which the remains of strings can be detected, indicate that it was, when in use, attached to some portion of the dress, or fastened on a staff.

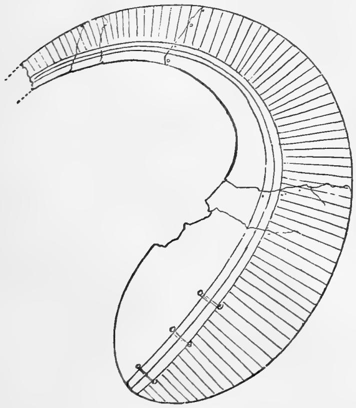


FIG. 6.

7. A fragment from the larger end of a piece similar to the preceding. Attached to this is a piece of cloth.

In addition to the foregoing, there are a number of small fragments, probably broken from these plates; but so far I have been unable to fit them to their proper places.

An examination of what Mr. Rogan calls a skin shows beyond question that it is animal matter. The matting he speaks of appears to be made of split canes.

FIG. 7.

The shell represented in Mr. Holmes's fig. 3, reproduced in our fig. 7, is the one obtained in grave *g*. The one shown in Mr. Holmes's fig. 4, reproduced in our fig. 8, is that found in grave *f*.

I shall not attempt at present to speculate upon these singular specimens of art, further than to call attention to one or two facts which appear to bear upon their age and distribution.

First, We notice the fact alluded to by Mr. Holmes, which is apparent to every one who inspects his accurately drawn figures, that, "in all their leading features, the designs themselves are suggestive of Mexican or Central-American work." Yet a close inspection brings to light one or two features which are anomalies in Mexican or Central-American

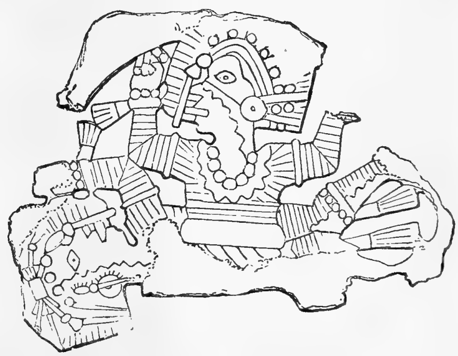


FIG. 8.

designs; as, for example, in figs. 3 and 4, where the wings are represented as *rising from the back of the shoulders*,— a fact alluded to by Mr. Holmes. Although we can find numerous figures of winged individuals in Mexican de-

signs (they are unknown in Central-American), they always carry with them the idea that the individual is partly or completely *clothed in the*

Fig. 9.

skin of the bird. This is partially carried out in our copper plate, as we see by the bird-bill over the head; the eye being that of the bird, and not of the man. But when we come to the wings, we at once see that the artist had in mind the *angel figure* with wings arising from the *back of the shoulders*, — an idea wholly foreign to Mexican art.

Another fact worthy of note, in regard to these two plates, is that there is a combination of Central-American and Mexican designs: the graceful limbs, and the ornaments of the arms,

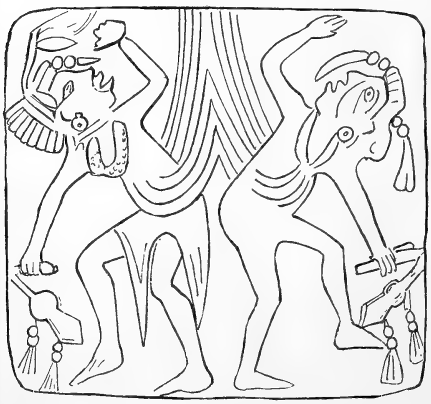


Fig. 10.

legs, waist, and top of the head, are Central American; and the rest, with the exception, possibly, of what is carried in the right hand, Mexican.

That these plates are not the work of the Indians found inhabiting the southern sections of the United States, or of their direct ancestors, I freely concede. That they were not made by an aboriginal artisan of Central America or Mexico of ante-Columbian times, I think is evident, if not from the designs themselves, from the indisputable evidence that the work was done with hard metallic tools.

Second, Plates like those of this collection have only been found, so far as I can ascertain, in northern Georgia and northern and southern Illinois. The bird figure represented in fig. 9 was obtained by Major Powell, the

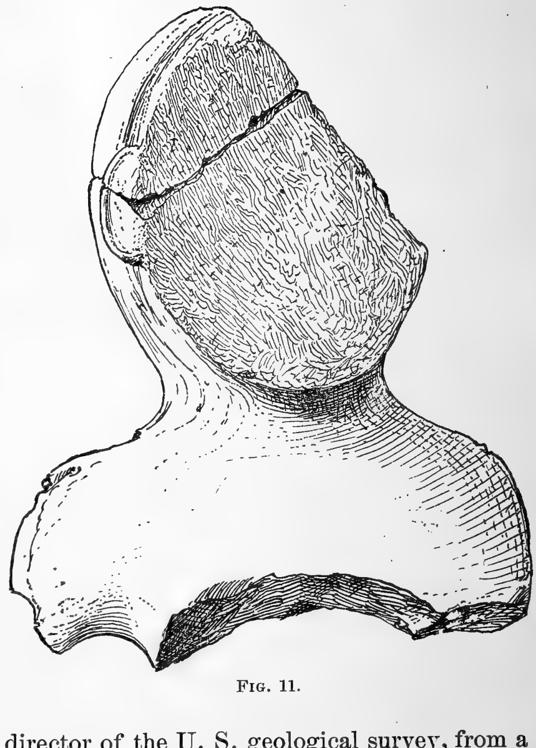


Fig. 11.

director of the U. S. geological survey, from a mound near Peoria, Ill. Another was obtained in Jackson county, Ill., by Mr. Thing, while engaged by the Bureau of ethnology, from an ordinary stone grave. From another similar grave, at the same place, he also obtained the plate represented in fig. 10. Fragments of another similar plate were obtained by Mr. Earle from a stone grave in a mound in Alexander county, Ill. All these specimens were received by the Bureau of ethnology, and are now in the National museum.

I cannot enter at present into a discussion of the questions raised by the discovery of these engraved shells; nor is it necessary that

I should do so, as Mr. Holmes has discussed somewhat fully these designs in the second annual report of the Bureau of ethnology. But I may add that these figured copper plates and engraved shells present a problem very difficult to solve, as is evident from the following facts: —

1°. A number of the designs bear too strong resemblance to those of Mexico and Central America to warrant us in supposing this similarity to be accidental. 2°. The indications of European workmanship are too evident to be overlooked. 3°. The fact that some of them were found in connection with articles of European manufacture is unquestionable. 4°. The evidence that some of the engraved shells can be traced to the Indians is well-nigh conclusive.

Mr. Rogan sank a large shaft, seventeen feet square, to the bottom of the second mound (marked *B* in Jones's plate, and also in Col. Whittlesey's figure). No burials or objects of interest were found in it, except the remains of four posts, extending four feet below the surface, placed in the form of a parallelogram, two feet one way, and six feet the other. The strata were as follows: first, a bottom layer of white sand two feet thick; next, between nine and ten feet of dark red clay; then two feet more of white sand; and, lastly, a top layer of some six or seven feet of dark sandy loam.

Mr. Rogan found in one of the small, low mounds east of the large one (those marked *FF* on Jones's plate), the fragment of a stone image. This fragment, which shows most of the form of the bust, is represented in our fig. 11. It is made of a coarse white marble: and the part shown in the figure is ten inches and three-quarters long; the length of the head, seven inches and a fifth; and width of the head, five inches and three-quarters. The face is entirely wanting, and from appearance, I judge, was broken off designedly.

CYRUS THOMAS.

A HUMAN SKULL FROM THE LOESS OF PODBABA, NEAR PRAGUE.[1]

AMONG collections of bones from the diluvium of the vicinity of Prague, human skulls are often found. From the color of the earth adhering to them, however, it is evident that they come from graves of the stone and bronze age, which here frequently occur in the top layer of the loess deposit, and are filled with dark loam. I also once received a normal skull found at a great depth in a lime-kiln at Tyrolka, not far from Prague, but in such relations that the overlying strata were presumed to have obtained their present position from a slide down the steep sides of the valley.

In the winter of 1883 some workmen brought me numerous bones of the reindeer, the rhinoceros, and the mammoth, from the clay behind the brewery at Podbaba, and, on the 30th of November, the remains of a human skull. After carefully putting together the newly broken parts, a skull was apparent, the remarkably depressed shape of the forehead of which must surprise every one. As this came from the same strata as the bones of ancient mammals obtained from this place, I immediately went there in order to determine more definitely the state of things. The skull was found by a workman named Hlavatý, in undisturbed brick-clay (loess) two metres thick, lying under one metre of dense loam, and at the same level at which, about a week previously, I had obtained the tusk of a mammoth.

FIG. 1. — LATERAL VIEW OF HUMAN SKULL, FROM DELUVIAL CLAY NEAR PRAGUE (ONE-HALF NATURAL SIZE.)

[1] Abstract of a communication to the Bohemian society of sciences, by Dr. ANTON FRITSCH.

The skull consists of the frontal bone, the whole left parietal, a fragment of the right as well as a part of the left temporal bone, with the petrosa. The occipital bone, the face, and the base of the skull, are lacking; but freshly broken surfaces indicate that the skull was complete, and that the missing fragments are lost. On this account, measurements according to the accepted rules could not be given.

I therefore sought for lines which would permit a comparative measurement with a modern skull. I joined the point of the upper edge of the orbit with that in which the parietal bones are connected at the end of their median suture, and from it drew a line perpendicular to the lower end of the mastoid process of the petrosa (see fig. 1). I did the same, also, to a normal skull, and ascertained by this means the great difference in the shape of the forehead, and the lowness of the skull arch. A measurement made in the same way, of the slope of the forehead in a normal brachycephalic Bohemian, amounts to seventy-two degrees, while the skull from Podbaba measures fifty-six degrees. In a normal skull, the height of the crown above this horizontal line is 7.2 centimetres; in the skull from Podbaba, 5.6 centimetres. The position of the outer opening of the ear may be reconstructed with some exactness by means of the channel running diagonally across the temporal bone. A further remarkable characteristic of the skull is the very strongly developed eyebrows, which, in their

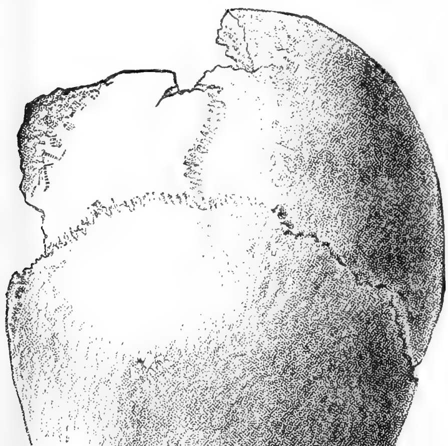


FIG. 2. — THE SAME, TOP VIEW.

inner half, are little inferior to the Neanderthal skull. A cross-section of the stoutest portion of the parietal bone shows that only the middle third is porous. The bone has nearly the same appearance as those of the diluvial mammals found in the same clay, commonly considered fossil. A few small fragments of the bones of the extremities were obtained with the skull, but their inter-relation would be difficult to prove.

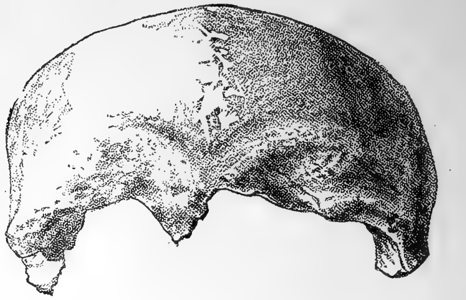


FIG. 3. — THE SAME, FRONT VIEW.

From the same clay a skeleton of a girl of the bronze age was recently brought to me, one hand still holding a bracelet, which had turned the distal end of the arm green. A few days later I obtained two nearly perfect skeletons of full-grown men from a neighboring lime-kiln. All these skeletons came from graves situated in the top layer of the loess and in the loam. All are typical dolichocephali, with beautifully arched foreheads. The bones are soft and fragile, and are at once distinguishable, on a glance, from the skull with low forehead found deep in the loess.

After repeated visits to the locality, I succeeded in determining that it was in precisely this layer, two metres below the loam, that all the mammal remains obtained at this place had been found; viz., a tusk of a mammoth seventy-five centimetres long, two skulls of Rhinoceros tychorhinus, reindeer, and horse. Since this is the same level from which the human skull came, it may be considered as established beyond doubt, that the mammoth, the rhinoceros, and man lived in Bohemia at the same period.

As I am no craniologist by profession, and am especially occupied with other paleontological material, I think I act agreeably to all anthropologists in sending the skull for further examination to Professor Schaaffhausen. This high authority, to whom I have already sent a plaster cast, declares it very interesting, and will be prepared shortly to report on it.

PRIMITIVE COMMUNITIES.

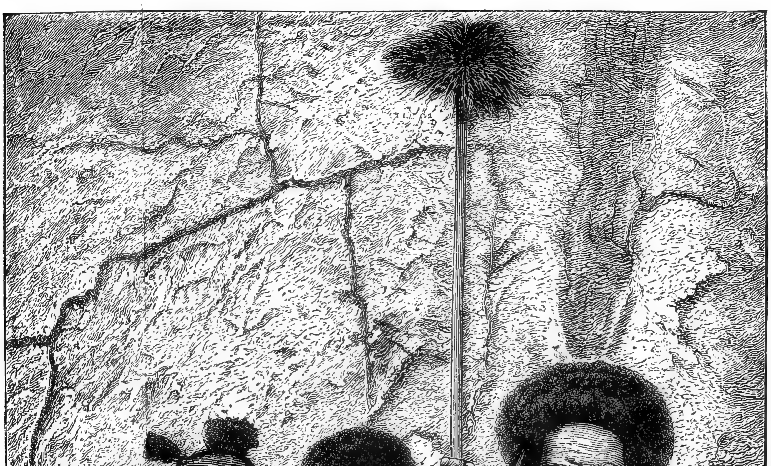
DURING the year 1883 three books were published which were of so great importance in the early history of institutions, that it seems worth while to examine them with some care in their relation to one another, in order to determine the precise extent and value of their contribution to this study. These books are, Sir Henry Maine's 'Early law and custom,' Mr. Frederic Seebohm's 'English village community,' and Mr. D. W. Ross's 'Early history of land-holding among the Germans.' Sir Henry Maine's book, being a collection of essays of a considerable range of discussion, will be touched upon only incidentally: the other two, those of Mr. Ross and Mr. Seebohm,

1 2 3

4

1, Amazonian idol; 2, Sepulchral urn of the province of Para, Brazil; 3, Figurine of terra-cotta, found in Utatlan; 4, Vase found in Tennessee; 5, Vase found in the Missouri River (?). — *La Nature*.

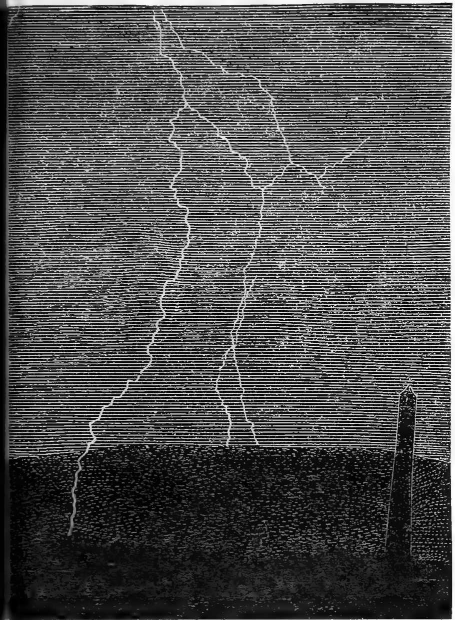
5



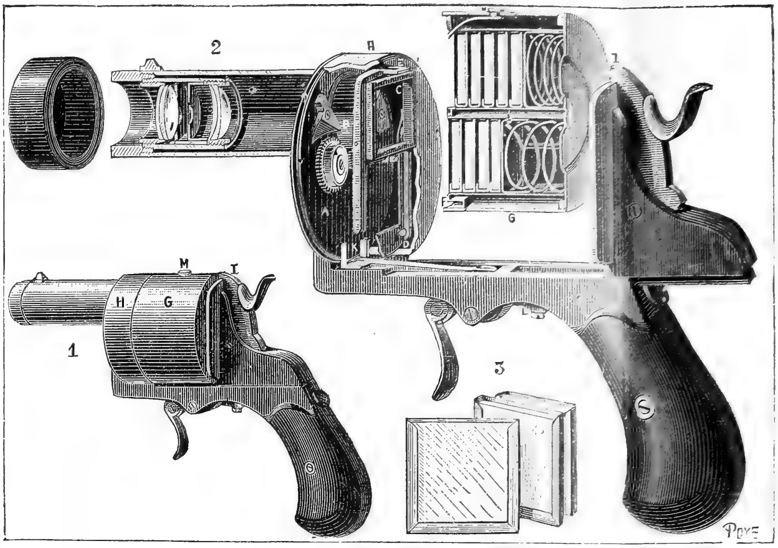
A group of Papuans. — *Science monthly*.

Breccia columns in th

SELECTED ILLUSTRATIONS FROM

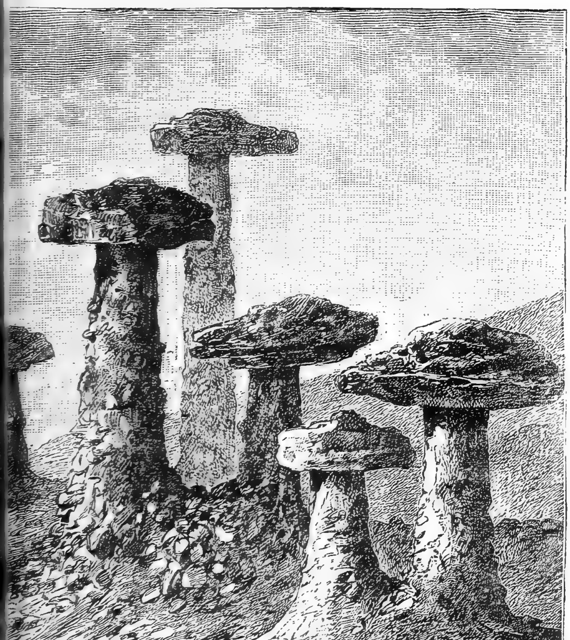


N INSTANTANEOUS PHOTOGRAPH OF A FLASH OF
ING, TAKEN BY ROBERT HAENSEL, AT REICHEM-
BOHEMIA. —*Naturen.*

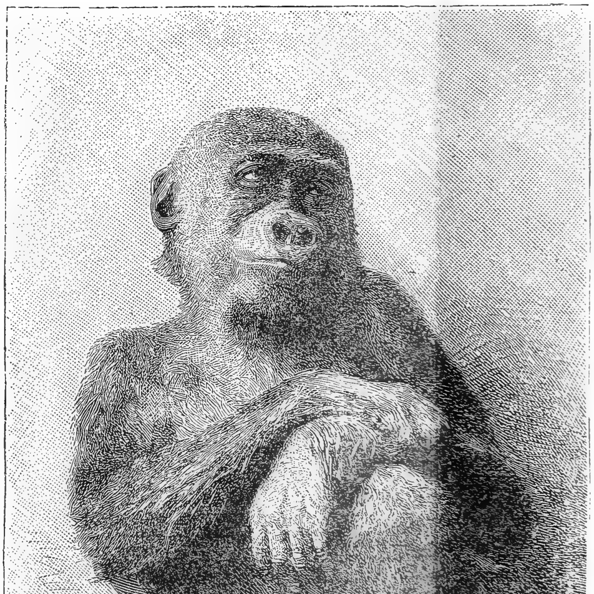


PHOTOGRAPHIC REVOLVER FOR INSTANTANEOUS PHOTOGRAPHY.

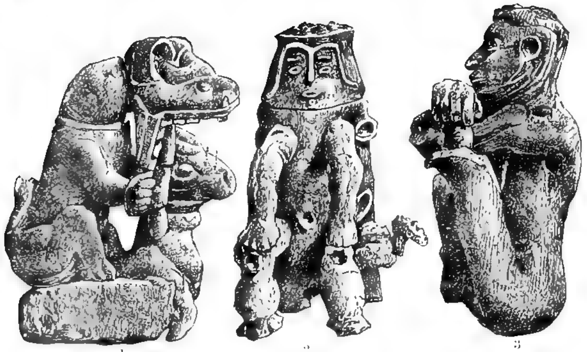
A, the shutter rotated by clock-work when the catch B is released from the teeth K by pressure on the trigger. After a plate has been exposed in the holder C, the barrel G is revolved by hand; and, the catch E being released by the inclined plane at F, the plate is transferred to the chamber for exposed plates (shown below in the figure). By continued rotation, the chamber of fresh plates is brought opposite the holder, and another plate pressed by the spring into the holder. — *La Nature.*



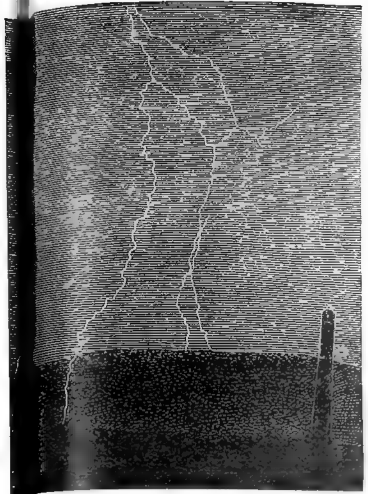
EY OF JAGNAOUS, KOHISTAN. — *La Nature.*



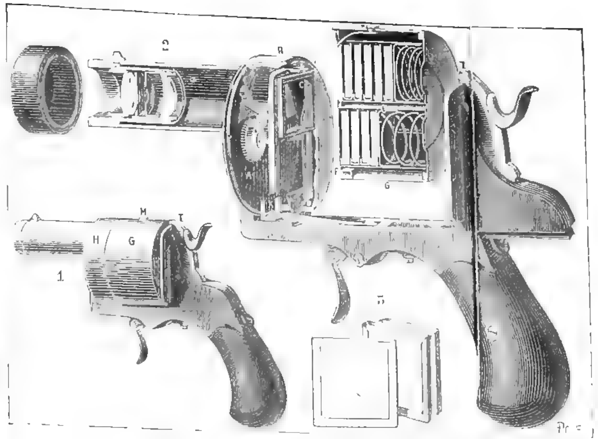
THE YOUNG GORILLA OF THE PARIS MUSEUM OF NATURAL HISTORY, FROM AN INSTANTANEOUS PHOTOGRAPH. — *La Nature.*



1, Amazonian idol; 2, Sepulchral urn of the province of Para, Brazil; 3, Figurine of terra-cotta, found in Utatlan; 4, Vase found in Tennessee; 5, Vase found in the Missouri River (?). — *La Nature.*

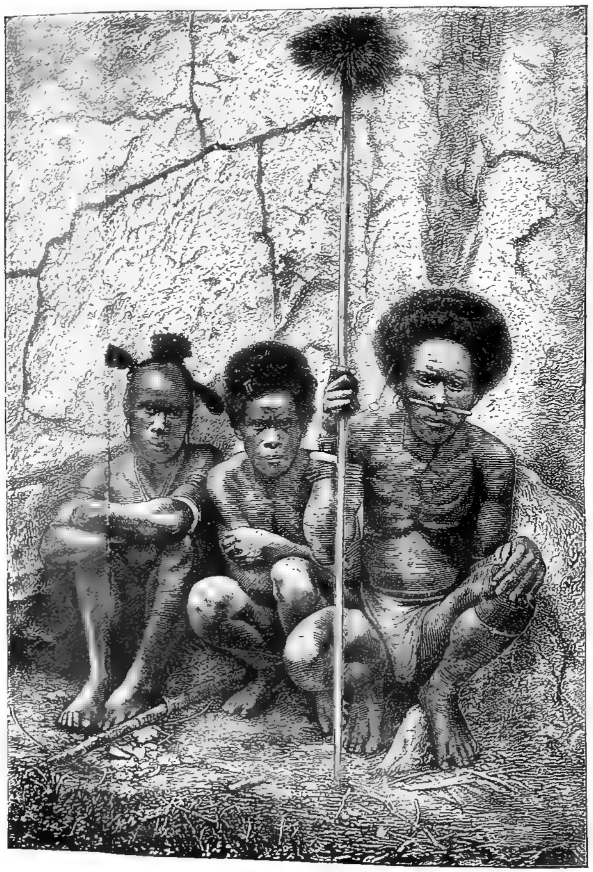


F[illegible] instantaneous photograph of a flash of l[illegible], taken by Robert Haensel, at Reichen[illegible] [illegible]ohemia. — *Naturen.*

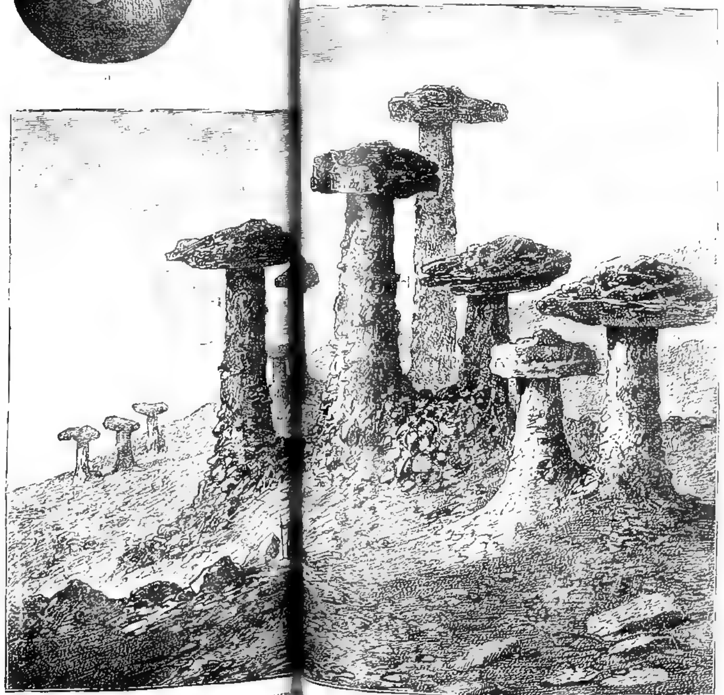


Photographic revolver for instantaneous photography.

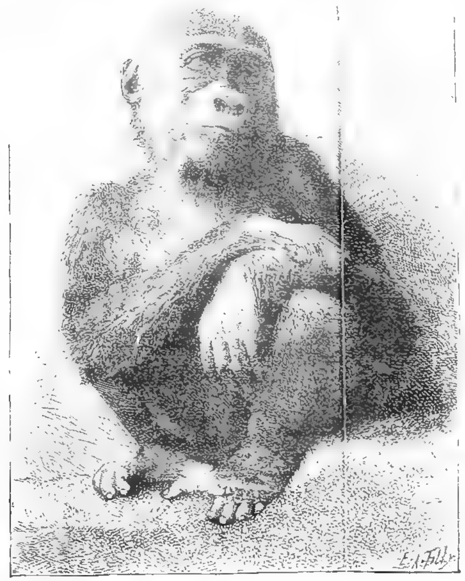
A, the shutter rotated by clock-work when the catch B is released from the teeth K by pressure on the trigger. After a plate has been exposed in the holder C, the barrel G is revolved by hand, and, the catch E being released by the inclined plane at F, the plate is transferred to the chamber for exposed plates (shown below in the figure). By continued rotation, the chamber of fresh plates is brought opposite the holder, and another plate pressed by the spring into the holder. — *La Nature.*



A group of Papuans. — *Science monthly.*



Breccia columns in the [illegible] of Jagnaous, Kohistan. — *La Nature.*



The young gorilla of the Paris museum of natural history, from an instantaneous photograph. — *La Nature.*

SELECTED ILLUSTRATIONS FROM [C]ONTEMPORARY FOREIGN JOURNALS.

Supplement to SCIENCE, June 27, 1884.

being in the same general line of investigation, and arriving at essentially the same results, deserve careful study by themselves.

The principal object of these two books, so far as they are controversial in character, is to disprove the accepted theory of village communities. The existence of village communities as a feature of serfdom, they readily accept; and Mr. Ross even recognizes certain *quasi* communities of freemen, of a comparatively late date, and of subordinate importance: but the agricultural community of free peasants, purely democratic in its structure, as a regular and necessary phase in the history of Germanic society, they either deny altogether, or accept as a merely transient and unimportant phenomenon.

It may be noted here, that neither of these treatises aims to cover the entire ground of the inquiry. Mr. Seebohm's investigations are, for the most part, confined to the English people, — an intruding people, settled by conquest upon a soil to which they were foreign. Here he appears to have completely established his thesis by a series of inductions of remarkable fulness and cogency, and to have shown that the evidence before us does not warrant us in going back of the *servile* community which we know to have existed in the middle ages. But when he passes from England to the original home of the English, he contents himself with the discussion of two or three points, of considerable interest and importance, it is true, but which do not go to the bottom of the matter. Mr. Ross pursues his inquiries by a precisely opposite method. Instead of working back inductively from the present to the past, he begins with the first settlement of the Germans in their permanent homes, and traces their landed institutions step by step down to fully historical times. Like all deductive processes, his reasoning depends for its force upon our acceptance of the proposition with which he starts.

This proposition is (p. 1), that "the freemen settled neither in villages nor in towns, but apart from one another, in isolated farmsteads." Of the evidence for this proposition, derived from chap. xvi. of the Germania of Tacitus, I spoke some months ago (see *Science*, No. 45), in a review of Mr. Ross's book. My object now is not to repeat what I said then, or to examine the proposition itself, but to bring it into relation with other connected branches of inquiry. Mr. Ross has given us an invaluable treatise upon early German land-holding; but landed institutions are only one of a group of institutions, and, however fundamental their importance, they cannot be fully understood, except in connection with the social organization and the political institutions of the people in question. Moreover, however fundamental the landed institutions are at the stage of civilization in which the Germans were at the time of the migrations, in the earlier stages of society they are of only secondary importance, and, indeed, only come into existence at a relatively late epoch in the life of any community.

Primitive communities stand in no relation to the land except that of occupation. Land is to them a free gift of nature, just like air; and individual ownership, or even permanent individual occupation, is inconceivable to them. For primitive communities, the most fundamental consideration is that of the social organization, — the structure of society: the relation to the land does not come into consideration until the people has passed through savage life and the lower stages of barbarism, and has settled down to permanent occupation and systematic agriculture. Then, upon the passage from the personal to the territorial basis of organization, the land becomes the subject of the first consequence. It is readily seen, therefore, that Mr. Ross, starting with individual property in land, leaves out of sight — as he has a right to do — all the earlier phases of landed relations, as well as the entire question of social structure. We cannot, however, fully understand the landed institutions themselves, or fully appreciate the bearing of Mr. Ross's researches, without bringing them into relation with these cognate branches of inquiry.

It will be well to diverge here for a moment to Sir Henry Maine's book, which raises a question similar to that under consideration. In chap. vii., 'Theories of primitive society,' he pronounces in favor of the 'patriarchal theory of society,' — that is, "the theory of its origin in separate families, held together by the authority and protection of the eldest valid male ascendant," — against the view presented by Morgan and McLennan, of its origin in the horde. That this was the history of society as we are in condition to trace it, especially in the Indo-European family of nations, there is no doubt; but the patriarchal family, like individual ownership of land, requires something back of it to account for its origin. It is not primitive, but must itself be the outcome of ages of gradual advancement.

The theory of the patriarchal family, as defined by Sir Henry Maine, lends itself readily to Mr. Ross's theory of landed relations. The German warrior, upon the settlement of his tribe in a new region, may be supposed to have taken a tract of land, and settled upon it with his sons and daughters, his slaves and serfs. From this beginning, the sketch of landed relations presented by Mr. Ross possesses unity and consistency. To accept it in full, however, as an exhaustive theory of the subject, we must not only agree to the interpretation of Tacitus, by which he establishes his premise, but must also bring his theory into harmony with what we know of the primitive social organization of the Germans.

It is generally agreed that the Germans, in the time of Caesar, — and these remarks apply also, in the main, to the time of Tacitus, a hundred and fifty years later, — were in what is sometimes called the semi-nomadic stage, but what we may, perhaps, better describe as the end of a series of migrations. There is good evidence that the intruding Germans had displaced Celts in some parts of Germany at a relatively recent date; and the great invasion of the Teutones and Cimbri at just the time of Caesar's birth, was, no doubt, a part of this general migration. This erratic movement of the Cimbri and Teutones was checked by the Romans with considerable difficulty; but an effective barrier was placed against the slow west-

ward advance of the Germans by Caesar's defeat of Ariovistus, the later campaigns of Drusus and Tiberius, and finally by the *limes*, or line of fortified posts constructed from the Rhine across to the Danube in the second century.[1] The Germans, at the time of Caesar, cultivated the ground to a certain extent, — a form of industry not inconsistent with the slow migration, occupying perhaps several centuries, by which they passed from their original home to central Europe. Once this migratory movement stopped, no longer finding scope for expansion, the Germans appear to have settled quietly within their now established boundaries, and to have passed with great rapidity into a settled condition of society, with permanent occupation of land, and a regular system of cultivating it.

At this point there is an absolute blank in our knowledge for a period of nearly three hundred years, after which time, in the weakness and disruption of the Roman empire, the Germans burst over the barriers which had held them stationary, and began a new series of migrations, of a very different type. These years, as I have said, are a complete blank, except so far as we are enabled to infer what happened during the interval, from what appears at its close. In the time of Caesar, and probably in that of Tacitus, when the *limes* was in process of construction, the Germans appear to have been still in the stage of temporary occupation of land by groups of kinsmen. What was the nature and organization of these family groups it is impossible to tell; only we have every reason to conclude that they were of far less importance in their system than in that of either Greeks, Romans, Slavs, or Celts. Like the Romans, the Germans advanced to the territorial or political stage at a relatively very early period; but while the Romans continued, even under their highly developed political system, to retain their gentile organization unimpaired, — although only as a branch of private law, — the corresponding institutions among the Germans were rapidly outgrown, and have left very slight traces in their later institutions. The larger subdivisions, which may very likely have been *gentes* in their origin, appear, in the time of Caesar and Tacitus, to have become purely territorial districts, in which, so far as our information extends, there is absolutely no feature of the family principle. They are administered, not by an hereditary or quasi-hereditary chief representing the original patriarch, as among the Slavs and Celts, but by elected magistrates (*principes*), in which no trace of the patriarchal origin is discernible; and so strongly developed are the political habits of the people, that these magistrates are elected by the entire nation in their public assembly, and assigned to the several districts.[2] Within these districts the family groups still continue, and receive annual assignments of land at the discretion of the magistrates. This is in the time of Caesar. In the time of Tacitus, even these lesser family groups appear to have lost much of their original character; for he does not mention it as a feature of their constitution. When we reach the settlement of the Angles and Saxons in England, we find that the *maegth*, or legal kin, was not a precisely defined group, like the Roman *agnatio*, but was irregular and fluctuating in the highest degree.[1] The same fact, the inferior importance of the kin as compared with all the other European branches of the Aryan race, is shown distinctly in the popular literature. In the story of Burnt Njal, for example, the patriarch lives surrounded by his sons and daughters; but so far is he from possessing the Roman *patria potestas*, that he has no power even to withhold his sons from the perpetration of a gross crime.

When the Germans come under our observation again, at the time of the migrations in the fourth and fifth centuries, we find, in place of the system of shifting occupation of land, a fully developed system of individual ownership. This Mr. Ross appears to have completely proved. That the ownership was not yet complete, for the purposes of alienation and devise, does not affect the main question. It was precisely so among the ancient Romans, who possessed the most vigorous and logical conception of individual property (*dominium*) in land which any people has ever had; nevertheless, the *paterfamilias* held this property in trust, as it were, for his heirs, without power either of alienation or devise. Here comes in the importance of the distinction made by Mr. Ross between *common* and *undivided* property. The land belonged to the freeman and his heirs, not to the community, and, when divided, was divided *per stirpes:* it was therefore not common, but undivided.

The question now arises, What connection was there between the system of shifting occupation described by Caesar and Tacitus, and that of individual ownership which existed at the time of the migrations? To answer this question, we have absolutely no positive data, but may arrive at certain inferences by following deductively the tendencies at work in the earlier period, or by detecting in the later period survivals of perished institutions.

It may be said that the natural course of events would be something like this. The family group, which in the time of Caesar received an assignment of land for a year at a time, appears in the time of Tacitus to have held it for a series of years; its family character being, perhaps, at the same time modified. This is what we should naturally expect, and it is the most probable explanation of the much-disputed passage in the twenty-sixth chapter of the Germania. This shifting occupation, the natural accompaniment of semi-nomadic or migratory life, would cease by the force of circumstances when this form of life came to an end. The German nations being confined within definite territories, divided into permanent districts, the lesser groups would likewise become fixed. The habits of settled agriculture, the attachment to lands and residences once occupied, would very soon transform the shifting occupation

[1] For the historical importance of this *limes*, see Arnold, Deutsche urzeit, book i. chap. iii.

[2] This subject I have discussed more fully in a paper in vol. vi. of the Transactions of the Wisconsin academy of sciences, arts, and letters, now in press.

[1] See Professor Young's essay upon Anglo-Saxon family law.

into a permanent occupation; and with permanent occupation comes in at once the idea of ownership. Ownership of land is the outcome of a settlement in permanent homes, and the adoption of a regular system of agriculture. This ownership would be of the group, the *universi* of Tacitus, and must be *common* ownership in the strictest sense of the word: for the shifting occupation of individuals or households (*quos mox inter se secundum dignationem partiuntur*) would continue for a while after that of the larger groups (*agri ab universis in vices occupantur*) had ceased; and in this interval there would be real ownership, because permanency of occupation, on the part of these larger groups (*universi*), originally themselves family groups in nature, and probably still so in their prevailing character. At last the same causes which had called into existence the common ownership of the larger group would create, in turn, the individual ownership of the household. This would probably be a very rapid process. Such as it is here described, as a probable result of known causes, it is precisely what Mr. Seebohm appears to have in mind (p. 367) when he says, "It is certainly possible that during a short period . . . tribal households may have expanded into free village communities." If it took place at all, it must have been in this period of blank between the construction of the *limes* and the migrations of the fifth century.

The free village community is therefore a natural and probable connecting link between what we know to have existed in the first century, and what we know to have existed in the fifth century. That it actually existed among the Germans during this epoch, we have no direct and positive evidence; but there are numerous features of the later system, in the community of cultivation, the rights of pre-emption, and the traces of occasional re-distribution, which are easiest explained as survivals of the village community. For a description of these, I need only refer to Sir Henry Maine's 'Village communities,' and similar works.

Of actual cases of village communities, indeed, in any country, it is surprising how few we have knowledge of, considering the large part they have played, of late years, in treatises upon early institutions. The villages of India are composed of independent families, joint or individual. Those of the South Slavonians are groups of house communities; the Celts never appear to have had any institution of this nature; the Greeks and Romans afford no traces of them; the German villages, as Mr. Ross has proved, were communities of independent proprietors, although bound together by ties, which seem to indicate a previous condition of collective ownership; Russia alone affords unquestionable examples of the village community of the theory. What is common to all of these, and may be fairly pronounced a universal institution of the Indo-European race, if not of the human race, in its early stages, is the family group with collective occupation of land. The nature and organization of the group, and the later history of its relation to the land, are questions into which we have not space to enter.

The obscurity and vagueness in the prevailing ideas upon the subject result from not attending to the fundamental character of the transition, in early society, from the personal structure of society (based upon the family relation) to the political organization (based upon territory). In the earlier stage we have family groups occupying a definite territory: in the later stage we may have a definite territory — the *mark* or village circumscription — occupied and owned in common by a group of proprietors. These proprietors may be the family group of the earlier stage, or they may have taken in members of different origin: in any case, the point of view has shifted, and is now territorial instead of personal. This condition of things, if it ever existed, is the free village community. W. F. ALLEN.

TECHNICAL EDUCATION IN EUROPE.

A SECOND and important instalment of the Royal commission, appointed in England in 1881 to inquire into the subject of technical education, was published on May 16. The preliminary report presented during the session of 1882 dealt exclusively with the condition of things in France, where educational development has been most remarkable. The percentage of illiterate conscripts in 1833 was forty-seven and eight-tenths: in 1867 it had fallen to twenty-three, and in 1880 to fifteen, per cent. The law of the 16th of June, 1881, which came into operation on the 1st of January following, decreed gratuitous instruction available for the working-classes throughout an extended series of schools, commencing with the Salles d'asile, which are being converted into kindergarten schools, and graded upwards to the 'superior elementary schools,' in which technical instruction is given, and trades taught. The commissioners appear to have been favorably impressed with what they saw of the handicraft teaching of the Christian brethren in France, Belgium, and Ireland. The combination of manual with ordinary literary instruction imparted to very young children appears to have been first tried in 1873, at the communal school in the Rue Tournefort, with such satisfactory results that schools of the same type are being rapidly and extensively established. "Drawing, modelling, and carving are taught as part of the curriculum; and lathes, forges, and joiners' benches are as much matters of course as desks and blackboards. In the Boulevard de la Villette is the apprenticeship school, established some twelve years ago by the city of Paris, for boys who have completed the ordinary primary-school course, and to whom is given what professes to be a very thorough training in the theory and practice of numerous handicrafts; the pupils especially distinguishing themselves as pattern-makers and engine-fitters. Nearly fifty thousand pounds is said to have been expended on the establishment of this institution, and nearly three thousand pounds is required for its annual maintenance." The abolishing of the old system of apprenticeship is the main object of this institution. The most striking examples of primary schools are to be found

in the Swiss cantons. In Zurich a communal school is described the building for which cost sixty-six pounds per pupil, — five times the much-complained of London average. There are no fees, and ninety-seven and a half per cent of all the children of school age are said to attend schools of this type. The average attendance is returned as ninety-five, — a remarkable contrast to the seventy-two per cent which was the average in England and Wales a year ago; and no proposal for the reduction of school expenditure can find a hearing as an election cry in Switzerland. Without a mine, a canal, or a navigable river, Switzerland carries on extensive cotton and silk weaving, paper-making, and calico-printing works; and the report grows quite enthusiastic on the aniline-color works of Basle, an abundant supply of skilful chemists being thoroughly trained in such institutions as the Polytechnicum at Zurich, or the Bernoullianum at Basle. The report shows that the higher educational institutions are as various in the different countries as they are generous and complete in most. In the German empire there are twenty-four universities. The buildings for the Strasburg university are now nearly complete, and are to cost six hundred thousand pounds. The department of botany has had a sum of twenty thousand pounds devoted to it; that of physics, thirty thousand pounds; and that of chemistry, thirty-five thousand pounds. The votes for maintenance are similarly ample. The rivalry between the universities and the polytechnic schools is wholesome, if costly. New buildings are now being completed at Charlottenberg, in which the work of the old technical high school of Berlin will be carried on. There are many intermediate schools between the primary schools and the universities and polytechnic schools. The 'Fortbildungsschulen' of Germany are very beneficial institutions. "The work of the primary day schools is carried on in evening classes with a direct and practical bearing on the occupations upon which the pupils have entered. But in every country, and notably in France and Belgium, there are night classes provided for the instruction of the industrial classes in drawing and modelling, directly applied to decorative art, as well as in popular science and general knowledge. Then, again, there are schools still more specialized for instruction in weaving, in practical mining, in dyeing, and in designing for every conceivable kind of artistic manufacture. This teaching is often gratuitous; but, where fees are exacted, they are always small; and there is everywhere prevailing a system of bourses and scholarships by which meritorious pupils are enabled to carry on their studies. The state, the province, and the commune bear the charges in their allotted proportions." The use of museums and art-galleries, open on Sunday for the benefit of designers, is much dwelt on by the commissioners, who embody a recommendation of Sunday opening in their report.

Mr Samuelson and his colleagues travelled at their own expense, and have spared no exertion to place their facts before the public in a complete and useful manner.

THE AGE OF STEEL.

The creators of the age of steel (on Sir Henry Bessemer, Sir C. W. Siemens, Sir Joseph Whitworth, Sir John Brown, Mr S. T. Thomas, and Mr. G. J. Snelus). By W. T. JEANS. New York, *Charles Scribner's sons*, 1884. 314 p. 8°.

IN this little collection of biography, the author has given a very interesting, and we may presume thoroughly authentic, account of the lives and the achievements of the great engineers who have during the past generation, 1850 to 1880, become famous as the 'creators of the age of steel.'

The list given by Mr. Jeans includes Messrs. Bessemer, Siemens, Whitworth, Brown, Thomas, and Snelus, but omits Mr. Mushet (in regard to whose claims a somewhat sharp controversy is now going on in the English periodicals), and makes no mention of two great American claimants for hardly less honor than is indisputably due to Bessemer himself, — Mr. Kelly, the contemporaneous inventor of the pneumatic process; and Mr. Holley, the great engineer, who by his wonderful ingenuity in the development of the details of the mechanical processes involved, and by his exceptional genius for designing automatic and efficient machinery, brought up the productiveness of our American establishments to double and treble that of those of European construction, and, in some cases, to several times the magnitude of output for which they were originally calculated.

The sketch of Sir Henry Bessemer is particularly full and satisfactory; and the author evidently feels unlimited admiration for the man, as well as for his work. He outlines the career of the exiled Anthony Bessemer, the father of Sir Henry, whose expulsion from France gave to Great Britain a family of whose achievements the world has learned to speak as those of its greatest benefactors. The father was no less ingenious than the son, and was famous, in his day, for his success in the arts of the gold-refiner and of type engraving and founding.

The son, now Sir Henry Bessemer, was born in England in 1813, and at a very early age exhibited his predilection for mechanics, and especially for its more artistic branches. He became a modeller, a designer, and an engraver, and invented new processes for use in the stamp-office, that were admired both for their singular ingenuity and for their efficiency. Losing the hoped-for reward for these inventions through those delays and those soulless methods characteristic of government offices,

he turned his attention to other lines of invention, producing a machine for working velvets, new type-making machinery, apparatus for making bronze powders, and other equally important and profitable devices. For many years previous to the conception of his greatest invention, the young man's mind was astonishingly prolific of valuable and remarkable devices and processes.

In 1853, when forty years of age, his attention was called to the importance of effecting improvements in the then crude forms of ordnance, and the unsatisfactory character of all ordnance metal. He devised a method of firing elongated projectiles from smooth bore guns, — a plan which had been attempted, but unsuccessfully, at intervals of every few years, from the time of probably its first and tolerably successful inventor, Robert L. Stevens, in the beginning of the century. The plan was to a certain degree satisfactory; but it brought out very strongly the evident necessity of obtaining a better metal for ordnance; and to this problem the young mechanic now addressed himself. Studying the problem in the truly philosophic manner, he saw that the end to be gained was the removal of carbon, and other impurities in the crude cast-iron, by some process that should do the work thoroughly, quickly, cheaply, and yet give a product in the form of ingot-metal. He saw that this could be done by a process of oxidation, and finally hit upon the idea of performing this operation by driving air, in finely divided streams, upward from a submerged reservoir, through the mass of molten cast-iron. This was the invention of the 'Bessemer process,' the greatest invention in the history of metallurgy. It was as simple, and apparently as obvious, a method of accomplishing the work, as can be conceived: its simplicity and obviousness are such as make it seem wonderful that it had not been done a century earlier. The story of Columbus and the egg here finds a parallel.

Some minor and accessory, yet essential, inventions were required to perfect the main invention, which delayed success some months; but they were in time perfected by the unconquerable Bessemer: and the process, after those delays which are inevitable whenever it is necessary to overthrow old methods in the introduction of new ones, became commercially successful. It was only, however, after Bessemer and his partners had built steel-works, and had shown on a full scale how far his devices were capable of yielding profit, that the iron-manufacturers and the steel-makers were induced to accept it as the coming steel-making process.

But the Bessemer process would be of comparatively little value, except for the invention of the now universal method of recarburizing — after the first operation, that of removing the silicon and carbon, is completed — by the use of 'spiegeleisen' or of ferro-manganese. It is this detail that gave the inventor success, after months of delay, within sight, apparently, of his goal. The question of priority of discovery of this method of recarburizing is still in dispute between the friends of Bessemer and of R. F. Mushet, and may never be fully settled to the satisfaction of either. There would seem to be no doubt that both of these metallurgists were working in this direction at the same time, and that both hit upon it at very nearly the same date. The fact, however, that Bessemer has never paid royalties to Mushet, is perhaps the best evidence, at least, of the legal status of the case.[1] No one will, however, question that Mushet was on this track when Bessemer was working at the same point; and it is most probable that he found the solution of the problem at about the same time with the more fortunate inventor. Bessemer has himself frankly acknowledged the importance of Mushet's share in the invention claimed for him. The fact seems to be, that Mushet used spiegeleisen, or ferro-manganese, while Bessemer was still trying to use the oxide of manganese.

This, in brief, is the history of the invention of the Bessemer process of making steel, — an invention which has, in the short space of a quarter of a century, completely revolutionized some of the greatest of human industries; which has reduced enormously the cost of making the 'mild' steels which are now, consequently, displacing iron in every department of manufactures; and which bids fair in a very few years, even if it cannot be said to be an accomplished fact to-day, to convert the iron-manufactures of the world into steel-manufactures, and which has thus inaugurated the 'age of steel.'

To make the story of the Bessemer process complete, the author of this little history should have told of the advances made in the United States, where the work done by Bessemer in Great Britain was first copied, then improved upon, till to-day the capacity for production has been enormously increased, works originally built for a production of thirty thousand tons per year having carried the figure up to from

[1] Mushet patented the invention, but three years later allowed the patent to lapse by non-payment of the stamp-tax.

a hundred and twenty-five thousand to a hundred and forty thousand tons. This wonderful gain has been entirely due to American genius, and principally to the splendid engineering of the late A. L. Holley, who told his friend Thomas, the inventor of the 'basic process' (who, when visiting the steel-works at Troy, looked for an ingot-mould on which to seat himself after a fatiguing tour of the establishment), that, if he wished to find an ingot-mould cool enough to sit upon, he must go back to England for it.

A sketch of Sir William Siemens follows that of Sir Henry Bessemer, and a very good account is given of the so-called Siemens process of making steel. For a short outline of the life of this wonderfully versatile inventor and engineer, the reader may turn to the columns of *Science* for Jan. 11; but he will find a more detailed story of his life in the Creators of the age of steel.

The Siemens process of steel-making differs from the Bessemer process, of which it is in some sense a rival, but with which it is more strictly a coadjutor, in being a slow and gradual operation, conducted upon the hearth of a reverberatory furnace, — an 'open-hearth' furnace, as it is often called, — instead of being a process of rapid reduction in a closed vessel, inaccessible to the operator at any time during the period of change. This slowness of transition from the condition of cast to that of wrought iron, and the perfect accessibility permitted by the use of the open-hearth furnace, afford the workman an opportunity to watch the process of evolution of carbon, and to check it, if he desires, at any stage; to increase or diminish the proportions of any element, as he may find it necessary; and thus to obtain with certainty precisely the quality that he seeks. In the Bessemer process, the right proportions must be hit upon at the right instant, or the error permanently injures the product, and cannot be rectified. In the Siemens process, if the metal is not right when ready to tap off, the operator can readjust the proportions of carbon or of manganese until he finds, by test of samples taken from the furnace, that it is precisely as he wishes it; and he can then cast it into ingots with a positive certainty that he will obtain a marketable product. In this process, too, the refuse scrap, the rail-ends, and other waste from the Bessemer converter, can be worked up; and by it a great market for scrap wrought-iron is made.

A long and sometimes sharp controversy has arisen between the friends of the two great inventors, and especially between the friends of Siemens and of Martin, who introduced this process in France, as to the priority and the relative merits of the inventions. The true facts of this case are probably correctly given by a committee of the Styrian metallurgical association, who voted that the principle of making cast-steel on the hearth of a reverberatory furnace was known at the beginning of the century, and that it was successfully practised in France in 1860; that Sir William Siemens invented the process of making steel in the Siemens regenerative furnace; that Martin discovered the proper mixtures for the commercial grades of steel; that the processes devised by the latter have been now superseded, and are of no present use. There is and can be no rivalry between the Bessemer and the Siemens processes, or their inventors. They occupy entirely different fields of production; and each is peculiarly adapted to making a special kind of steel, and to working up materials such as the other is least fitted to handle. Each has its place in our industrial system, and each is of direct and substantial value to the other. The Bessemer process will probably make the bulk of our steel rails, and the Siemens process will probably supply us with the best of boiler-plate, for an indefinite period of time. We shall always find a field open to both, and shall always see each taking its own place, and filling it in a manner that the other cannot imitate.

The original Siemens process was one in which the carbon was removed from cast-iron, partly by dilution with wrought-iron scrap-metal, and partly by oxidation in the flame of the reverberatory furnace of Siemens, and also, perhaps, to some extent by 'dissociation.' This method of making 'mild steel' involved the use of a large quantity of scrap, and although at first a very economical process, and continuing to be economical so long as scrap-iron flooded the market, as it did at the first, became uneconomical, comparatively, as the price of wrought-iron scrap advanced. Siemens then introduced his so-called 'ore process,' in which the reduction of the carbon was effected by the use of the ores of iron. The process as now usually conducted, under the direction of the agents of the inventor, is a mixed ore and scrap process.

The peculiarity of the product of the Siemens process is the wonderful uniformity, toughness, and purity of the metal. The most stringent demands of the engineer are readily met by the open-hearth steel-maker; and the most delicate shades of quality are obtained with an ease and accuracy that are approached by

no other known methods of making mild steels in large quantities. This is the only kind of steel in general use for boiler-plate, for bridge-work, or for general construction. The largest and finest steamships in the world are now made of this material, and their machinery is gradually absorbing a larger and larger proportion of the same kind of metal; and the time is probably not far distant when it will have completely displaced iron for all ordinary purposes of engineering construction, — as completely as has Bessemer steel displaced its rival in the manufacture of rails.

The great bridge over the Firth of Forth, with its two spans of seventeen hundred feet each, is to take forty-two thousand tons of Siemens steel. The one firm of Elder & Co. of Glasgow, the pioneers in the introduction of the marine compound engine and of steel ships, uses some twenty thousand tons of this steel per annum. In the ship-building trade, over two hundred and sixty thousand tons are now used each year.

There are now over a hundred and fifty open-hearth furnaces in operation in Great Britain alone, exclusively for the manufacture of the Siemens steel. It has been found possible to obtain temperatures sufficiently high to remove phosphorus, that bane of the steel-maker; and now moderately phosphuretted ores are worked for steel. The scrap-iron used is to a considerable extent obtained from the Bessemer works, which supply rail-ends and other waste.

Space does not permit more than a mention of the other minor, but nevertheless great, ‘creators of the age of steel.’ Sir Joseph Whitworth has, by a system of compression of the molten and solidifying ingot, given us a steel so perfectly sound and free from ‘blow-holes’ that it may be used for a thousand purposes for which ordinary steel is entirely unfitted. This steel is made by the ordinary processes, and, when poured into the ingot, is immediately placed under the plunger of a very powerful hydraulic press, and there subjected to a pressure of a thousand or two thousand tons; under which enormous load every pore is closed up, and the steel solidifies in a compact mass of such fineness of structure, that no microscope, and no physical or mechanical test, can detect the slightest defect in homogeneousness. Its strength and its ductility are such that the inventor tests the ordnance which he makes of this metal by securing the shot in the gun so that it cannot be driven out; and then, firing the charge behind it, the whole mass of gas resulting from the combustion blows out at the ‘vent’ without injury to the gun. No such test was ever dreamed of by any ordnance officer, or attempted with any other kind of ordnance metal.

Sir John Brown, the proprietor of the great iron and steel works at Sheffield, famous for the magnitude of the armor-plates often made there, was the first manufacturer in Great Britain to countenance Bessemer in his endeavor to make a new steel, and was the first to put up a Bessemer converter, after the early experiments of the inventor had indicated a probable success. The armor-plating of ships — an invention of our countryman, Robert L. Stevens of Hoboken — was adopted in England during the Crimean war, at about the time that the Emperor Napoleon made the first attempt to make armored vessels of service in attacking the forts at Sevastopol. Sir John Brown was one of the first of the British iron manufacturers to fit up works for the purpose of making heavy plate. He soon added Bessemer works to his establishment, and produced steel for the general market. His armor-plate is now made as a ‘compound’ plate, consisting of an iron backing, with a facing of steel,— a combination of which more is expected than from the simple construction. The magnitude of the works may be imagined from the fact that there are in use a hundred and sixty steam-boilers, supplying steam to the amount of eleven thousand or twelve thousand horse-power.

Other great promoters of the revolution now in progress are Messrs. Gilchrist and Thomas and Snelus: they have done much toward the reduction of the cost of making steel by the modern processes, by making it possible to use the cheap phosphuretted ores which had previously been unavailable. The new method of operation of the Bessemer process, which has effected this change, and which, as Mr. Carnegie says, has “done more for England's greatness than all her kings and queens and aristocracy together,” consists simply in the lining of the converter with materials having a basic reaction, and in the introduction of similar material with the charge. Lime is the base found best adapted to the purpose; and its use has, after long experiment and the expenditure of much time and money, been made practicable by Messrs. Thomas and Gilchrist, and Mr. Snelus. At extremely high temperatures, and in the presence of lime, phosphorus will pass from the molten iron in the converter into the lime with which it meets in the lining of the vessel, and which is added before the blow; and the steel is thus freed from its most persistent and

dangerous impurity. Mr. Snelus seems to have been the first to work out this problem, and it was then perfected by the other inventors mentioned. The success of the process is to a considerable extent dependent upon the mechanical details of the plant and of its operation, — details perfected, in part, by the late Mr. A. L. Holley, one of whose latest inventions was a form of rapidly removable converter especially adapted to this modification of the older process. This new method has not been introduced as rapidly outside of Great Britain as in that country, where the scarcity of pure ores renders it of very great importance. In the United States the abundance of ores comparatively free from phosphorus renders the steel-maker to a great extent independent of the 'basic process.' All of the larger makers now have their own mines of good 'Bessemer ores,' and do not feel much interest in this latest of the great inventions of the opening age of steel.

The 'creators of the age of steel' have rendered inestimable service to mankind, and all mankind will be interested in reading the story told by Mr. Jeans. R. H. THURSTON.

THE GUATEMALTEC LANGUAGES.

Zur ethnographie der republik Guatemala. Von OTTO STOLL. Zürich, *Orell Füssli & Co.*, 1884. 9+180 p., map. 8°.

A grammar of the Cakchiquel language of Guatemala. Translated by D. G. BRINTON. Philadelphia, *McCalla and Stavely*, 1884. 72 p., map. 8°.

To suppose that dialects of the Maya family are the only languages spoken by the Indians of this extensive Central-American republic would be at variance with existing facts, although they cover, indeed, the largest part of its area. The present tribes speaking allophylic languages (that is, languages belonging to other families) are the Pipil Indians, speaking an Aztec tongue, and now found in two districts only (near Escuintla, Salamá, etc.); the Pupuluca Indians, on the border of San Salvador, belonging to the Mije stock; and the Caribs, at the mouth of Rio Dulce and in the adjacent territory of Honduras, who still speak the language of the Lesser Antilles. Otto Stoll, who, during a five-years' stay in the mountainous parts of Guatemala, has made extensive linguistic and ethnographic studies of the aborigines, has established the above classification, and also mentions the former (if not present) existence of two other dialects which may possibly form linguistic families for themselves, — the Sinca on the southern coast, and the Alaguilac on Middle Motagua River, both from the historian Juarros.[1] The first three of the above languages are illustrated by vocabularies and linguistic comparisons with cognate dialects.

Of sixteen Maya dialects, the learned investigator offers a useful and complete vocabulary extending over three hundred terms. Subjoined to these are short texts, conversations in Indian, historic and ethnographic notices from the conquest down to our times, and an elaborate bibliography. To judge from their lexical and grammatic character, the dialects have evolved, according to Stoll (pp. 173–175), in the following historic order from the parent language: —

1. *Huastec* forms the most archaic group, now separated from all the others by its northern location.

2. *Maya*, with its subdialects of Peten and Lacandon.

The following groups (3–6) have detached themselves from the Maya of Yucatan, and their forms are of a much less archaic type: —

3. *Tzental* group, embracing Chontal of Tabasco, Tzental proper, Tzotzil, Chañabal, Chol, — all in southern Mexico; Mopan in northern Guatemala.

4. *Poconchi* group, embracing Qu'ekchi, Poconchi, Pocomam, Chorti, in central and eastern Guatemala.

5. *Qu'iché* group, comprehending Qu'iché, Uspantec (dialect discovered by Stoll), Cakchiquel (the dialect studied more especially by the author), Tz'utujil, — all in south-western Guatemala.

6. *Mam* group, comprehending Ixil, Mam, Aguacatec, in the western sections of the republic.

The third group constitutes a much younger branch of the Maya of Yucatan than the fourth, fifth, and sixth groups.

The Cakchiquel language is a Maya dialect, spoken on the Upper and Middle Motagua River, and around Guatemala, the capital of the republic of the same name. It was therefore called also 'lengua metropolitana' and 'lengua guatemalteca.' By request of the American philosophical society of Philadelphia, Dr. Brinton has just translated and published in its proceedings, and also in a handy, separate edition quoted above, a Spanish grammar of that language, dated 1692, and composed by an unknown author. To render the exposition of the language, which is extremely harsh of pro-

[1] Sinca is declared to be a Mixtec language by Alphonse L. Pinart.

nunciation, more complete, Brinton has added extracts from two manuscript grammars of his own library, — that of the Dominican Benito de Villacañas, who died in 1610; and that of Fray Estevan Torresano, composed shortly after 1753. Cakchiquel possesses a rich literature, consisting of theological and some semi-historical works of native writers, of which but little has ever been printed. A map facing the titlepage points out the location of the principal tribes.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Publications. — Although advance copies of the third annual report of the survey were issued some time ago, it was incomplete as regards the illustrations. The complete report, bound, has now been received at the office, and will soon be distributed. ——The fourth annual report has been issued, although it is not yet ready for distribution. It contains five hundred and five pages (i.–xxxii., 1–473), and is illustrated with eighty-five plates and fifteen figures. The report of the director presents a *résumé* of the operations of the survey for the fiscal year ending June 30, 1883; and the administrative reports following give a more detailed account of the work. The latter are by Messrs. Henry Gannett, Arnold Hague, G. K. Gilbert, C. E. Dutton, T. C. Chamberlin, R. D. Irving, S. F. Emmons, G. F. Becker, O. C. Marsh, C. A. White, C. D. Walcott, L. C. Johnson, L. F. Ward, Carl Barus, and Albert Williams, jun.

The accompanying papers are by Capt. C. E. Dutton, Mr. Joseph S. Curtis, Mr. Albert Williams, jun., Dr. C. A. White, and Mr. Israel C. Russell.

Capt. Dutton's paper is on Hawaiian volcanoes, and consists of thirteen chapters, covering a hundred and forty pages, in which the geography of the islands, and their volcanic phenomena, are described. The paper is illustrated with twenty-nine plates and three figures. The paper by Mr. Joseph S. Curtis is entitled "Abstract of a report on the mining geology of the Eureka district, Nevada." It occupies twenty-eight pages. A general outline of the district is given. The structure of 'Prospect Mountain' and of Ruby Hill are detailed; and the occurrence and source of the ore, and the future prospect of Ruby Hill, are considered. Three plates present a horizontal section and two vertical cross-sections. Mr. Albert Williams, in fifteen pages, treats of popular fallacies regarding precious-metal ore-deposits. 'A review of the fossil Ostreidae of North America, and a comparison of the fossil with the living forms,' by Dr. Charles A. White, follows Mr. Williams's paper. There are two appendices to Dr. White's paper: viz., 'North-American tertiary Ostreidae,' by Professor Angelo Heilprin; and 'A sketch of the life-history of the oyster,' by John A. Ryder. The whole paper, including the plate explanations, occupies a hundred and fifty-two pages, in which there are forty-nine full-page plates. 'A geological reconnoissance in southern Oregon,' by Israel C. Russell, a paper of thirty pages, with three plates and ten figures, and the index of nine pages, complete the volume.

Bulletin No. 3, 'On the fossil faunas of the upper Devonian along the meridian of 76° 30′ from Tompkins county, N.Y., to Bradford county, Penn.,' by Henry S. Williams, was issued in May. It contains thirty-six pages, four of which are devoted to the index, and is the first of a series of articles on the comparative paleontology of the Devonian and carboniferous faunas. The price of this bulletin is five cents.

Bulletin No. 4, 'On mesozoic fossils,' by C. A. White, is all in type, and will soon be issued. The total number of pages, including the explanations of plates, is a hundred and twenty-four. There are three papers, as follows: "Description of certain aberrant forms of the Chamidae from the cretaceous rocks of Texas;" "On a small collection of mesozoic fossils collected in Alaska by Mr. W. H. Dall;" and "On the nautiloid genus Enclimatoceras Hyatt, and a description of the type species." There are nine woodcut plates.

Bulletin No. 5 is by Mr. Henry Gannett, chief geographer of the survey, and is almost ready to be issued. It contains three hundred and twenty-six pages, and is called 'A dictionary of altitudes in the United States.' Mr. Gannett began the compilation of measurements of altitudes when connected with the Geological and geographical survey of the territories; and three different editions of the results were published by that organization, the last bearing the date of 1877. They related principally to the country west of the Mississippi, while the present work embraces the whole country. The elevations are arranged alphabetically under the states and territories.

Bulletin No. 6, 'Elevations in Canada,' by J. W. Spencer, is in press, and supplements bulletin No. 5.

Bulletin No. 7 is also being rapidly put into type. It is entitled "Mapoteca geologica Americana: a catalogue of geological maps of America (north and south), 1752–1881, in geographic and chronologic order," by Jules Marcou and John Belknap Marcou. This catalogue is modelled on 'Mapoteca Colombiana,' by Uricoechea of Bogota, which was published in London in 1860, and is now out of print, and rare. Besides a list of some thirty numbers relating to maps on the geology of America, in Cotta's 'Geognostische karten unseres jahrhunderts,' published at Freiberg in 1850, the only list of geological maps of America is the 'List of general geological maps relating to North America,' in the 'Geology of North America,'

by Jules Marcou (p. 122), published at Zurich in 1858. When it is remembered how the publication of American geological maps has increased in the past twenty-five years, the importance of this catalogue will be appreciated.

Bulletin No. 8, 'On enlargements of mineral fragments in certain rocks,' by Roland Duer Irving, is also in press. It will be illustrated with one woodcut plate, five chromolithograph plates, and four woodcuts.

Bulletin No. 7 begins the second volume. A number of other bulletins are in course of preparation, and will soon be sent to the printer. —— Monograph No. vii., 'Silver-lead deposits of Eureka, Nev.,' by Joseph Story Curtis, is all in type with the exception of the index. It has a hundred and ninety-three pages, and will be illustrated with sixteen plates and ten figures. —— Monograph No. viii., 'Paleontology of the Eureka district,' by Charles Doolittle Walcott, is also in press, and is being rapidly put into type.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Society of arts, Massachusetts institute of technology.

May 22. — A paper by Mr. J. M. Batchelder was read by the secretary on the electro-deposition of iridium on engraved copper plates. A process had been used by Mr. Batchelder over twenty years ago; but it did not seem to have become known, and was presented as comparatively new. The solution was prepared by fusing iridium and osmium with three times their weight of nitrate of potassium for about one hour at a bright-red heat. A fused mass was broken into small pieces, and treated with nitric acid, in a glass retort with a condenser. The osmium was separated out, and the iridium which remained was treated with chlorhydric acid, after removing the nitrate of potassium by crystallization. The solution contained about one-eighth of an ounce of iridium to a gallon of water, to which about one-quarter pound of sulphuric acid should be added. The plate is to be immersed, and connected with the battery, as usual, and, when removed, will be found coated with iridium, closely resembling the common steel plates. Such plates, coated with iridium, were very durable, and possessed many other advantages. A plate was shown which had been exposed twenty-seven years without protection; and its surface was still brilliant and uninjured. It is more easily wiped than a copper plate, the surface being, in this particular, about the same as a steel plate. —— Mr. S. H. Woodbridge read a paper on the heating and ventilation of the new Institute building, and the special principles involved. The building had not been planned with special reference to any accepted system of ventilation, and only the circumstance of hollow walls rendered the introduction of such a system possible. Some of the more prominent features of the heating and ventilation system adopted are: the reversal of the ordinary custom of subordinating ventilation to economy in heating; basing the quantity of air required on determined requirements rather than on cubic capacity simply; the use of large areas of air-passages, and low velocities; making the outlet areas smaller than the inlet areas, and some peculiar features of the flues; heating by large air volumes at low temperatures instead of by small volumes at high temperatures; some modifications in the construction of the fan, increasing the efficiency; the method of controlling the temperatures of the coils; the method of determining the rate of condensation, and the daily aggregate condensation as a means of critical study, and of determining the cost of the heating and ventilation; and placing the ventilation and the temperature of each room under control of the engineer. The building measures about 150 by 90 feet, is 75 feet high, and contains some forty rooms, from 3,000 to 60,000 cubic feet in capacity. In determining the requisite air-supply, regard was had to the maximum number of occupants, and the character of their work. Ordinary lecture-rooms receive 1,500 cubic feet per hour for each person; physical laboratories, where some gas-flames are used, get 2,000; ordinary chemical laboratories, 3,000; the organic chemical laboratory, 4,000; and libraries, 2,000. The total capacity of the rooms is about 741,000 cubic feet, and the mean total air-supply about 3,535,000 cubic feet per hour, corresponding, with a uniform distribution, to a change of the entire air every twelve minutes. In the chemical laboratories, however, the air is changed every six or seven minutes. There are 79 flues, three feet by one foot, with a total area of about 230 square feet; and nearly one-half of these had to be located in the outside walls, notwithstanding the objections to such an arrangement. The finish of the flues is rough brick. Each inlet flue connects with but a single room, and the inlet is at about the middle of the height. The outlets are at the top and bottom of the room; the former being used only in hot weather, while the latter are always open. There are three valves or dampers on the outlet flue, — one at the top, a check-valve at the bottom to prevent a reversal of the draught, and one at the top outlet of the room. The inlet flues also have three dampers. The flues terminate in a sub-basement four feet high, under the whole building, with a concrete floor. The air enters through large windows, and, after passing through the main coil, passes through the fan into the fan room, open on three sides, to the sub-basement. The fan is twelve feet in diameter, with twelve floats, and has a free delivery over its entire circumference. The power it requires is very small. Calculation showed that the cost of heating the new building would be much greater than that of heating the old, on account of thinner walls, and other sources of loss, besides the greater quantity of air supplied. The

matter of the heating had been put into the hands of Mr. F. Tudor. The main coil heats the air to 50° or 60° C., and a supplementary coil at the foot of each flue heats it as much higher as required. As the steam main is below the boiler level, and the return below the tank for condensed water, the arrangement of these coils was quite difficult. Mr. Tudor's fractional valve is applied to each coil, and so adjusted as to just fill the coil with steam; only the condensed water escaping at the lower end, and draining into a tank, from which it is raised by a Davidson pump. The boilers and engines are all in another building, some hundred and fifty feet away. The Davidson pump serves as a water-meter to register the quantity of water condensed in the coils. For this purpose a cylinder around which a piece of paper is wound is revolved by clock-work, and a pencil so connected with the pump piston that it is gradually moved in the direction of the axis of the cylinder by the action of the pump. The length of stroke and size of cylinder being known, an automatic record is thus obtained, showing the quantity of water condensed. It also affords a means of studying many other points, as it shows the time of letting on steam and shutting it off, of starting and stopping the fan, of opening the windows, etc. From the quantity of water condensed, the amount of coal which should be consumed in heating and ventilating the building may be calculated. With the aid of this automatic apparatus, Mr. Woodbridge had studied the matter of cost, and had discovered a considerable waste, though he had not yet been able to arrive at its cause. The results of the system are fully as satisfactory as were anticipated. Professor Nichols has studied the chemical composition of the air, and has found in the case of one room, after it had been fully occupied for one hour by eighty or ninety students, the following proportions of carbonic acid expressed in parts in 10,000, — Feb. 9, 4.3; March 5, 6.1; March 11, 4.5, — thus showing practically no contamination. In regard to moisture, Mr. Woodbridge thought a relative humidity of 40% at a temperature of 65° was sufficient, as with a low relative humidity it is much easier to keep the air sweet. As a whole, the work is highly satisfactory, not because perfect, but because in so many respects it meets the wants it undertook to satisfy.

New-York microscopical society.

May 2. — Mr. Charles H. Denison, in a paper on the gold sands of California, said that the coast of California from its northern to its southern boundary, for a length of nearly seven hundred miles, is strewn with magnetic iron sand, or comminuted magnetite, carrying gold and some other metals. He described the discovery of gold in these sands at Gold Bluff, where the indications are, that the spot was once the mouth of an immense river, now extinct. The process of mining for gold among these sands was described; but this process, said Mr. Denison, has not proved profitable. On the Klamath River the gold is associated with the same sand, and with platinum and iridosmene; while, on the great San Joaquin River, zircons and stream cinnabar are its additional associates. He mentioned, that, while the black sand is water-worn, the quartz is sharp and splintery, as if never subjected to the action of water. Nevertheless, beneath Table Mountain, where it was satisfactorily proved that it had been deposited by water, the gravel had the same sharp features.

NOTES AND NEWS.

IN order to allow an interchange of courtesies between the British and American associations, and enable the members of the two associations to attend both meetings, the meeting of the American association for the advancement of science, this year, will take place at a later date than usual.

The council of the British association has invited the fellows of the American association to join in the meeting at Montreal on the footing of honorary members; and the American association and the local committee of Philadelphia have invited the members of the British association, with their near relatives who may be with them, to take part in the Philadelphia meeting. Invitations have been sent to the leading scientific societies abroad, inviting them to send delegates to the Philadelphia meeting. The probabilities, therefore, are, that the Philadelphia meeting will be largely international in its character; and it is likely that steps will be taken to form an international scientific association. At the same time with the association meeting, the International electrical exhibition will be taking place in Philadelphia, and probably at the close of the week an electrical congress will be held. Other bodies will also be in session during the week, among them the Pennsylvania state agricultural society and the American institute of mining-engineers.

The local committee are actively engaged in perfecting their arrangements for the accommodation of the large number of persons which the unusual circumstances will call to Philadelphia; and, while the contemplated arrangements provide for two thousand members of the association, it is earnestly requested by the committee, that they be notified as early as possible of the intention of members and their families to be present. All members who intend to be at Philadelphia should therefore notify the local secretaries at an early day, and at the same time give their addresses where the 'Local circular' will reach them, if they are to be absent from their permanent homes during the summer. Definite information in relation to lodgings and transportation will be given in the 'Local circular,' with much other important information.

A series of receptions will be offered the association and its guests, including one at the Academy of music after the president's address, a reception at the Academy of fine arts, a garden party at Haverford college, and a microscopical exhibition at the Academy of natural sciences. The botanical section of the Academy of natural sciences will hold at the academy a special meeting for botanists. There will also be visits to the International electrical exhibition, the

Zoölogical gardens, Fairmount park, Independence hall, and other places of interest; and the various institutions in the city will welcome the association to their halls. During the meeting, free excursions will be offered, to the seashore, the anthracite-coal regions, and other places of interest, and possibly limited excursions to more distant points after the meeting. Special botanical and geological excursions will also be made.

The local committee are now preparing a map and guide-book for the use of members. The association post-office will be established in the Academy of music, under charge of Gen. Huidekoper, postmaster of Philadelphia; and letters and packages bearing the letters A.A.A.S. will be delivered there. Special free telegraphic facilities for personal messages have been secured, including the use of the transatlantic cable for the benefit of foreign guests. The transportation of specimens, apparatus, etc., will be attended to by the local committee, who will give particulars on receiving applications through the local secretaries. Every possible care will be taken of objects sent for exhibition or use during the meeting, and a suitable hall will be provided for their exhibition. It is hoped that members having specimens or apparatus of particular interest will exhibit them at the meeting.

The meeting will be called to order, in general session, at ten o'clock on Thursday morning, Sept. 4, in the Academy of music, by President C. A. Young of Princeton, who will resign the chair to the president-elect, Prof. J. P. Lesley of Philadelphia. After the adjournment of the general session, the sections will organize in their respective halls. General sessions and sections will be held on Friday. The vice-presidents of the sections will probably give their addresses during the day; and in the evening President Young will deliver his address at the Academy of music, after which there will be a reception tendered to the members of the association and their invited guests by the local committee and citizens of Philadelphia. Saturday will probably be given up to excursions and receptions. The general programme for the rest of the meeting will be similar to that at previous meetings.

The headquarters of the association will be at the Academy of music, which is on Broad street, in the centre of the city, very near the station of the Pennsylvania railroad and several large hotels. The sections will be amply accommodated in other halls in the immediate vicinity.

The offices of the permanent secretary and local committee, the association post-office, etc., will be at the Academy of music after Sept. 1: previous to that they will be at the Academy of natural sciences. The permanent secretary will establish his office in Philadelphia on Aug. 22.

The officers of several of the sections are arranging for special topics of discussion for the different days of the meeting. A committee of section D has already sent out a special circular. The vice-president of section E wishes it to be known that several papers have been already promised upon the subject of the crystalline rocks, which will probably form a special topic for discussion by geologists; and that it is proposed to assign particular days to prominent subjects in geology, a large number of papers being expected. The officers of the sections are ready to receive suggestions from members; and any special plans for the advancement of the work of the sections will be made known on application.

—The annual meeting of the society for the promotion of agricultural science will be held in Philadelphia during the meeting of the American association.

—The first mail from Kadiak Island received this season has arrived at San Francisco, bringing dates to May 2. According to the correspondent of the *Bulletin*, the account of the eruption of the volcano on Augustine Island, Cook's Inlet, sent by the last advices of 1883, was much exaggerated. The island "was not split in two, and no new island was formed; but the west side of the summit has fallen in, forming a new crater, while the whole island has risen to such an extent as to fill up the only bay or boat harbor, and to extend the reefs, or sea-otter rocks, running out from the island in various directions." The hunting-party feared to be lost has arrived safely in Kadiak. No tidal waves were observed on the west shore of Cook's Inlet or on Kadiak Island. The winter had been very mild, the mercury not having fallen below 10° F.; and spring began in March, wild-flowers being in bloom in the latter part of April.

—We had occasion to review in *Science*, some time ago, the cardinal characteristics of the scientific work of the leading nations considered as a whole; and the fact was noted that German ideas have set a common standard in scientific research, which is accepted in most European countries. No English-speaking person, interested in the history or progress of investigation, nowadays would think himself competent to work in any scientific field without a pretty thorough first-hand knowledge of what had been previously written on the subject in at least two or three foreign languages, in particular the German. It is perhaps not too strong a thing to say, that no school in this country has pursued a better method of study, or done more good in the direction of assisting the learner to acquire a really useful knowledge of German and French, than the Summer school of languages, which has been held in the halls of Amherst college for a number of years past. We learn that the school will be continued this year under the general direction of Professor Montague of the department of modern languages in that college; that the department of German instruction will be in charge of Professor Heness, principal of the school of modern languages at New Haven, and Professor Zuellig, late of Boston; and that the incentives to and the facilities for acquiring this language at the coming session of the school are expected to be of a high order. The department of French will be in charge of Professor Bernard, late of L'École Albert-le-Grand, Paris; and a department of Latin and Greek will be conducted this year, as formerly, with Professor Shumway of Rutgers college as principal. As is well known, the

instruction at the Summer school of languages is based on what is popularly called the natural or inductive method, only modified according to the genius and individuality of each teacher. Only the language to be learned is used as the medium of communication; and the aim is to so interest the learner in the study, that his work becomes, instead of a task, a pleasure and an inspiration. If results may be regarded as a sufficient indication, the method appears to be the best by which the pupil is taught, not only to read, but also to write and speak the language, and to understand it when spoken by others. These ends were quite impossible to attain within a brief period by the old systems; but very rapid acquirements of the learner, according to the new method, become possible from the opportunities offered of hearing and speaking the language several hours each day with a native teacher; thus conducing to a great familiarity with the new tongue, approaching as nearly as may be the advantages actually derivable from sojourn on foreign soil.

— A meeting of the trustees of the Peabody museum of archeology of Harvard university was held at the museum in Cambridge on the 20th inst. After an inspection of the several rooms, and the method of arrangement of the collections illustrating the development of mankind in early times in various parts of the world, and the arts and customs of existing races, the Hon. Robert C. Winthrop called the meeting to order, and, in very complimentary terms to the curator, expressed the satisfaction of the trustees with the methods adopted and results secured. Other members of the board also expressed their satisfaction with the appearance of the museum, and the work of the curator and his assistants; and, on motion of the Hon. Stephen Salisbury, Dr. Wheatland was requested to enter upon the records of the board an expression of the appreciation of the trustees of the work of the curator, and their perfect satisfaction with his arrangement of the collections.

Mr. S. H. Scudder called attention to the explorations which had been made under the auspices of the museum, of which the curator, Mr. F. W. Putnam, then gave a brief account, dwelling particularly on those by Dr. Metz and himself in the great mound of the Turner group, in the Little Miami valley, Ohio. On motion of Professor Asa Gray, the curator was requested to prepare a full account of the Ohio group, as soon as the exploration shall be completed, for publication by the museum, and also to present a paper on the same topic at the approaching meeting of the American association for the advancement of science, that these important explorations by the museum may be more widely known. In accepting this very pleasant duty, the curator stated that it would be necessary to obtain a thousand dollars at once, for the further promotion of the Ohio explorations, which were being conducted in the most thorough and scientific manner. John C. Phillips, Esq., the treasurer of the board, stated that there were no funds available for the purpose; but he thought the importance of the work warranted a call for subscriptions to aid the museum in this exploration, and said that he would most willingly give a further contribution of two hundred dollars for the purpose. Mr. Salisbury offered another hundred dollars, and the curator was authorized to obtain additional subscriptions with the assistance of the trustees. Subscriptions can be made to J. C. Phillips, treasurer, State Street, Boston, to any of the trustees, or to the curator at the museum. Due credit for all contributions will be given in the annual reports of the trustees.

— The London health exhibition was very far from complete on the opening day. The dairy department, however, was in full work; many varieties of churn being in use, and butter at one shilling and ninepence per pound made before the visitors' eyes, if they had patience to wait for it. One dairy company had a cow in the stall to prove the genuine nature of the original material. Among the most interesting exhibits were some specimens of ensilage, — one from Lord Walsingham's, being in very good condition; and another from Lord Tollemache's, having been in the silo since June 13.

— A cable despatch from Dun Echt, June 21, announces an ephemeris of Tuttle's comet; but as yet it is not known whether the comet has been seen since the chance observation at Vienna, May 26. The ephemeris, as cabled, is as follows: —

Date.	Right Ascension.	Declination.	Light.
	h. m. s.	*deg. min.*	
June 21	17 23 04	+28 51	1.16
June 25	17 21 00	+27 01	–
June 29	17 19 20	+25 09	–
July 3	17 18 36	+23 14	0.80

On neither of the probable returns of this comet, since its discovery by Mr. H. P. Tuttle at the Harvard observatory in 1858, has it been seen.

— At the meeting of the Society of arts, held on May 14, a new word was brought into currency by Professor Fleming Jenkins, who read a paper on 'Telpherage,' which he defined as a designation of all modes of transport effected automatically by the aid of electricity. The particular scheme under consideration was the forwarding vehicles by means of electricity along a single suspended wire or rod. Here a model was shown consisting of two concentric octagons of wire, round which two trains steadily ran. The lecturer denied that the plan was intended to compete with steam or ordinary electric railways: it was merely intended as a mode of transporting heavy goods. The cost, he calculated, after allowing for maintenance and outlay, would be twopence per ton per mile. Where railways did not exist, and might not promise to pay the cost of construction, he thought he might with confidence predict that this invention would prove of value.

— A bronze equestrian statue of Gen. Dufour was erected on the Place Neuve at Geneva, Switzerland, on the 2d of June. The president and other notabilities of the confederation were present, together with an immense concourse of people. The success

of the occasion was enhanced by one of those beautiful days of spring for which Switzerland is so justly celebrated.

Guillaume Henri Dufour (born at Constance in 1787; died at Geneva the 14th of July, 1875) is the most conspicuous figure of Switzerland during the nineteenth century. His popularity as a general who three times commanded the Swiss army — twice under very trying circumstances, such as the civil war of the 'Sonderbund' in 1847, and the Prussian war-pressure of 1855–56 — is well deserved. He will also be remembered as the president of the first international congress of the Red cross society. But it is as a *savant* that we shall consider him. The orator of the day, Col. Aubert, president of the committee of the monument, said, "As a topographical engineer, he conceived, directed, and executed for the confederation that splendid map of Switzerland which leaves far behind it all that had previously been done of the same kind, reaching a perfection which has been copied, perhaps attained, but never yet surpassed,"— a just appreciation of so distinguished a topographer.

Dufour's map, the official 'Carte topographique de la Suisse,' in twenty-five sheets (scale 1 : 100,000), is a true *chef-d'oeuvre*, a veritable model. A reduction in four sheets, on the scale of 1 : 250,000, also constructed under his direction, is a still more exquisite specimen of topography. We should be glad to see our government follow the lead of the Swiss republic, and give to its citizens, and to the scientific, agricultural, industrial, and commercial world, such a boon as a topographical atlas of the entire country, on the scale of 1 : 100,000, and thus supply an actual need of the present time.

The geodetic triangulation of Switzerland was begun by Dufour in 1832; and by agreement with the Piedmontese and French governments, which had undertaken a similar triangulation, the summit of the mountain of La Dôle, in the Jura, was considered as the terminal point of the three surveys. Major Delcros, of the topographical corps of the French engineers, starting from Havre and Paris as a base, was the last to finish its work: the two other observers had taken for the bases of their triangles, one, the shores of the Lake of Constance and the valley of the Upper Rhine, and the other the plains of the River Po; and to their delight, on comparing notes with Delcros, a difference of less than three metres was found for the elevation of the summit of La Dôle above the level of the sea, — a very remarkable case of exactness, when we consider the time and means; for it was long before the electric telegraph, the prismatic-light observations, and the very perfect instruments now in use.

— Dr. Dominik Kammel von Hardegger, a wealthy Austrian and eager sportsman, proposes to start in the ensuing autumn for Harar and the Somal country. He will be accompanied by Dr. Philipp Paulitschke, professor of geography at the University of Vienna, who has just published 'Die geographische erforschung der Adal-länder und Harar's' (Leipzig, *Frohberg*), an elaborate essay on the geographical exploration of the countries which the expedition i likely to visit.

— We learn from *Nature* of June 12 that a new scheme of a polar expedition has been recently submitted by several officers of the Russian navy to the minister, Admiral Shestakoff. Starting from the idea that it is impossible to reach the north pole by sea on account of the archipelagoes that cover the circumpolar region, the Russian officers propose to start an expedition on sledges from the New Siberia Islands, which are nine hundred nautical miles distant from the pole. This space is to be covered by sledge-parties, who would make depots of provisions on the newly-discovered islands, and thus slowly but surely advance towards the north, securing at the same time the return journey of the expedition. When elaborated, the scheme will be submitted to the learned societies, and the necessary money raised by subscriptions.

— The death of Dr. Robert Angus Smith, on May 12 will be a great loss to science, as well as to a large circle of friends to whom his kind heart and sympathetic nature had endeared him. Dr. Angus Smith was born near Glasgow, Feb. 15, 1817. He was educated first at Glasgow, then studied chemistry at Giessen, under Liebig, from 1839 to 1841. A report which he presented to the British association in 1848, on the air and water of towns, gave a great impulse to the question at that time; and a paper on the air of towns, in the *Journal of the chemical society* of 1858, first produced data establishing the differences of the town and country air, wherever found. His latest discovery, by which he tested the amount of injurious gas likely to arise from water more or less contaminated with sewage, was noted in *Science* only a few months ago. Dr. Angus Smith was for many years government inspector of chemical works, and had been a member of the Royal society since 1857.

— The Milan society for the commercial exploration of Africa has organized a circumnavigation of Africa, with a view of affording the pupils of the High school of commerce, and others, an opportunity of becoming acquainted with likely markets for Italian products. The steamer will leave Genoa on the 1st of September, and the whole voyage will occupy four months. A professor is to lecture during the voyage on the commercial geography of Africa.

— Stanley's note-book of his Kongo experiences from the 24th of August, 1883, to January, 1884, has been published in Brussels. He gives an account of the important expedition from Stanley Pool to Stanley Fall, which solved a geographical problem. He followed the Kongo to the mouth of the Aronhonimi; and his explorations established the identity of that stream with the Quené, which was discovered by Schweinfurth. The banks are thickly populated, but the people not warlike; and the villages are rich in ivory and other African products. The style of architecture is different from that on the banks of the Kongo. Stanley met with no opposition, though he encountered a fleet of above a thousand boats. He reports that the condition of the settlement of the

International society is very satisfactory, and Leopoldville increasing rapidly.

— The report of the Ohio meteorological bureau for April gives, in addition to the usual statistical tables for its twenty odd stations, a descriptive account of the Jamestown tornadoes of April 27, by E. H. Mark, secretary. There seem to have been two adjacent but separate tornadoes, moving easterly about sixty miles an hour. One of them had a path about seven miles long; and the other, thirty miles, of which eleven miles were skipped over without damage. The width of the paths varied from two hundred feet to a quarter of a mile. Rain and hail fell to one side of the track, and sometimes on the track as well; but it is not stated whether the latter happened before, during, or after the passage of the funnel-cloud. About three hundred buildings were destroyed or damaged, besides many smaller outhouses and sheds of which no note was taken; and five persons were killed. Trees four feet in diameter were snapped off like twigs; cows were lifted over fences, and whirled around in the air; an iron bar six feet long, and weighing about a hundred pounds, was carried a hundred and fifty feet across a canal, and lodged in the fork of a tree. The violent action of the first tornado began at the meeting of two clouds, — a heavy, dark cloud from the south-west; and a light, yellow one from the north-west. A witness of their combat said, 'The dark cloud whipped the yellow one.' The ordinary funnel-cloud was formed from their union, and performed all the usual freaks, swaying from side to side, 'bounding over the country,' rising and falling 'like a ball attached to a rubber cord.' It is to be regretted, that, in the description of the apparent movements of the cloud, forms of expression are used that imply a downward motion. An abstract of Mr. Finley's characteristics of tornadoes is appended, both to call attention to the observations that should be made on passing storms, and to point out how their danger may be best avoided.

— The May number of the *Journal of the anthropological institute* contains President Flower's address on the aims and prospects of the study of anthropology. The great difficulty of the study of anthropology, he said, is the multifarious nature of the branches of knowledge comprehended under the title. The most important elements of difference between races are: 1°, structural characters; 2°, mental and moral characters; 3°, language; 4°, social customs. All these should be carefully studied by those who have any share in the government of people belonging to races alien to themselves.

— Mr. W. F. Denning of Bristol has computed, from his own observations made in the early part of 1869, and in February of the present year, a new value of the rotation-period of the planet Mars. He observed the central meridian passages of the 'hour-glass,' or 'Kaiser Sea,' as being the most prominent and suitable feature on the planet for such comparisons; and the result of his discussion gives, for the sidereal rotation-period of Mars, $24^h\ 37^m\ 22^s.34$, the interval covering 5,349 rotations. This period is in good agreement with those derived by Kaiser, Schmidt, and Proctor, from much longer series of observations. Mr. Denning also collects the principal previous determinations of this constant, and has, in all, six values (all within $0^s.6$ of each other), the mean of which is $24^h\ 37^m\ 22^s.626$. This corresponds to a daily rate of 350°.8922.

— Mr. Sereno E. Bishop of Honolulu has added sixteen pages to the Krakatoa literature in a little paper on the 'equatorial' smoke-stream from Krakatoa, in which he wishes to call more especial attention to a phenomenon consequent on the great eruption, that he thinks has not received sufficient notice. This is the "swift, strong fling from the eruptive column of Krakatoa of a vast stream of smoke, due west with great precision along a narrow equatorial belt at an enormous velocity, nearly around the globe." If the facts as here stated are fully confirmed, there will certainly be a remarkably rapid westward propagation of sunset effects to be explained; but the method of explanation suggested by Mr. Bishop is very unsatisfactory in assuming a limit to the atmosphere at forty-five miles altitude. Beginning with this unwarranted assumption, the author supposes that the volcanic gases, vapors, and finest dust would form a flat, conical accumulation over the point of eruption and above the atmosphere. Down the slopes of this flat cone, the gases would slide with accelerated velocity, but chiefly to the westward on account of lagging behind the meridian of eruption (the lagging is given as twenty-six miles an hour at an elevation of a hundred miles, but should be fifty-two miles an hour); and thus the rapid westward propagation of the sunsets can be accounted for. There can be no question as to the *tendency* to action somewhat in the manner here suggested; but whether this tendency will be fully realized is very questionable, unless decidedly greater elevations than a hundred miles were reached. The presence of some thin remnant of an atmosphere, even above a hundred miles, is demanded by observations on meteorites; and the condensation of volcanic vapors at that altitude would be very rapid. The neglect of these facts is a serious weakness in Mr. Bishop's theory.

— Honolulu papers of latest date report a renewal of the red sunsets.

— The new *Zeitschrift für wissenschaftliche mikroskopie und für mikroskopische technik*, edited by Dr. W. J. Behrens of Göttingen, makes a good impression by its first number, being very attractively printed, and having good contents. There are eight original articles upon various practical matters, a series of abstracts of the important recent contributions to microscopical technique, and several reviews of books lately published. Now that the art of preparing objects and using the instrument has progressed in so many directions, microscopical science needs a journal devoted to technique; and we trust this new suitor for subscriptions will find support to make it thrive. The present number of the *Zeitschrift* contains a list of papers referring to matters of microscopical technique, and published between Jan. 1 and Dec. 1, 1883. Hereafter the lists will be quarterly.

— The principal question to be discussed in Geneva, at the summer congress of the Red cross society, is the neutrality of hospital ships.

— John A. Ryder has reprinted, from the annual report of the U. S. fish-commission for 1882, a long essay with several plates on the embryology of teleosts. The author brings forward many interesting observations, and shows evident familiarity with the literature of the subject, although he does not appear to always judge the value of previous publications correctly; for instance, when he quotes Hoffmann's observations on segmentation. He has a little eccentricity of nomenclature, writing of 'embryography,' 'yelk,' etc., and applying the term 'germ-layer,' not to any part of the germ, but to the ectoplasm of the ovum! The essay contains a certainly unnecessary number of lengthy extracts and abstracts from earlier writers. Why must there be so much padding in our government publications? We must condole with Mr. Ryder on his plates, for the care and skill he displays in drawing are sadly obliterated by the photo-engravings. We can only protest against the blind infatuation with which the fish-commission rejects all good means of illustration, and insists upon the exclusive use of process cuts, which represent very few things well, and are the worst possible means of representing delicate and transparent embryos.

The essay itself contains many valuable observations. By an amusing inadvertence, New-York harbor is said to be filled with a unique fluid; for its waters "were found to have *less than half* the normal average specific gravity of those of the open sea"! The italics are ours. Ryder has studied principally the ovarian ova, the formation of the germinal disk, segmentation, the formation of the neurula, and as much of the organogeny as can be followed out upon the transparent embryo. The work has been done with evident care and patience, and is to be supplemented by further researches, partly by the aid of sections. The observations made as to the formation of the germinal disk, the relations of the vitelline sac, the development of the ribs, muscle-plates, and fins, may be signalized as being of especial interest and importance. It must be doubted, however, whether Ryder's view as to the significance of what he strangely calls the 'yelk hypoblast' can be accepted.

— The report of the entomologist, published in the last report of the U. S. commissioner of agriculture, contains an account of the lepidopterous insects which infest cabbage in this country; a report on the causes of destruction of evergreen forests in northern New England, and New York, by Professor Packard; a report of progress in experiments in the destruction of scale insects, by H. G. Hubbard; and accounts of the imported elm-beetle, and the lesser migratory locust. The report is illustrated by thirteen full-page plates, about one-half of which are original.

— At the meeting of the Royal geographical society, held in London on May 12, it was announced that gold medals had been awarded to Mr. A. Colquhoun and Dr. Julius Haast. That given to Mr. Colquhoun as for his journey from Canton to the Trawadi at Rhamo in 1882, during which he executed surveys of the whole route from Wa-Chan (a hundred and fifty miles west of Canton) to Talifu, thirteen hundred miles of which had never before been surveyed. The medal to Dr. Haast was in consideration of his systematic explorations of the southern islands of New Zealand, — in the course of which he ascertained the altitudes of a hundred and thirty stations, and collected material for a map, the manuscript of which he presented to the society, — and for his numerous contributions to our knowledge of New Zealand.

— The Albert medal of the Society of arts has been awarded by the council of the society, with the approval of the Prince of Wales (the president), to Capt. James Buchanan Eads, "the American engineer, whose works have been of great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

— Herr Ernst von Hesse Wartegg is starting on an exploring expedition in Mexico and Central America to collect material for his new work on the archeology of those regions.

— Reports from Cape Colony state that Dr. Holub's plans are approaching success, in spite of his early difficulties with the colonial customs-house, which demanded duty on his explorer's outfit and scientific instruments. The aid sent from Europe has enabled him to cross the Transvaal, and enter the interior of Africa from there. During his involuntary stay in Cape Town, he explored the Somerset Mountains, where he made some interesting ornithological studies, and despatched specimens to Europe. The collections of the fauna and flora of South Africa, which he intends to make on his wanderings, he has promised to divide among the societies which have contributed to the expenses of the expedition.

— The twelfth annual session of the American public health association will be held Oct. 14–17, 1884, at St. Louis, Mo., and the following topics are proposed for consideration: Hygiene of the habitations of the poor, Hygiene of occupations, School hygiene, Adulteration of food, Water-pollution, Disposal of sewage by irrigation or chemical action, The observable effect upon the public health of official sanitary supervision, The work of municipal and state boards of health. Extensive preparations are now under way for making this the largest meeting that the association has ever held; and the committee urge the attendance and co-operation of persons in all trades and professions, interested in the advancement of public health and general sanitary science.

— Mr. G. F. Kunz, at the meeting of the New-York academy of sciences, May 19, exhibited a yellowish-green cut gem of fluorite chlorophane, from Hunter county, Va., and remarked, that, although too soft for gem purposes, this stone was possibly the first gem cut that phosphoresced without any great heating. The gem was passed around in a vial of warm water, and in the dark showed a very plain pale-green light.

INDEX TO VOLUME III.

**** Names of contributors are printed in small capitals.*

ERRATA.

Page 26, col. 2, 27th line from bottom, for 'Nat-sîs-aú' read 'Nat-sîs-añ.'
" 26, " 2, 10th line from bottom, for 'Mo-eu-kap-i' read 'Mo-en-kap-i.'
" 67, " 1, 26th line from bottom, for 'Eutania' read 'Eutaenia.'
" 137, " 1, line 9, for 'calciferous' read 'calciferus.'
" 188, " 2, lines 4 and 14, for 'Cullie' read 'Sands.'
" 189, " 1, line 6, for 'Cullie' read 'Sands.'
" 216, " 1, lines 1 and 2, omit 'an abundance of macrospores, besides.'
" 296, " 2, 4th line from bottom, for 'Dendroica' read 'Dendroeca.'
" 316, " 2, 14th line from bottom, for '*m*' read '*k*.'
" 337, " 2, 20th line from bottom, for 'larval' read 'larvae.'
" 345, " 1, line 3, for 'Bredicton' read 'Bredichin.'
" 394, " 1, 18th line from bottom, for 'Coriacus' read 'Cariacus.'
Page 494, col. 2, 14th line from bottom, for 'caniliculata' read 'canaliculata.'
" 648, " 2, line 24, for 'Mytalus' read 'Mytilus.'
" 693, " 2, 2d paragraph. The rocks mentioned did not come from the Silver-Cliff district, but from the same locality as the specimens mentioned on p. 667, col. 1, 2d paragraph.
" 723, " 2, 13th line from bottom, for 'deodorizing' read 'odorizing.'
" 737, " 1, 8th line from bottom, for 'Mayenia' read 'Meyenia.'
" 740, " 1, 4th line from bottom, for 'on' read 'and.'
" 795, " 2, line 21, for 'a hundred and twenty-four' read 'thirty-six.'
" 796, " 2, line 6, for 'a hundred and ninety three' read 'two hundred and thirteen.'
" 799, " 2, 22d line from bottom, for 'telepherage' read 'telpherage.'